Risk Management Assistance Team

Terwilliger Fire – OR-WIF

McKenzie Ranger District, Willamette National Forest
August 30 – September 2, 2018

Introduction

Risk Management Assistance Teams (RMAT) are small groups of experienced Line Officers and wildland fire managers who provide decision support for complex wildfires. RMAT provides assistance to Agency Administrators (and Incident Management Teams) with the decision-making tools, enhanced analytics, and alignment needed for making risk-informed choices when managing wildfires. RMAT's role is to bolster the Agency Administrators' (and Incident Management Teams') abilities to examine alternative strategies that better consider the inherent risk trade-offs, the risk to highly valued assets, and opportunities for fire benefits.

In 2017, RMAT tested concepts and tools on 15 wildland fires. This year, we are building from our successes and lessons learned to further assist Agency Administrators with improving their decision quality. The Terwilliger Fire was RMAT's fourteenth assignment of the 2018 fire season. This assignment was a good example of incidents where RMAT can assist local Agency Administrators in expanding their decision space through enhanced analytics and a systematic risk/risk trade-off analysis of the potential response strategies for their incident.

More information about RMAT and information directly related to this deployment can be found at https://wfmrda.nwcg.gov/RMAT.html in the File Cabinet located at the top of the RMAT home page.

The RMAT was ordered by the Pacific Northwest Region (R6) on August 29, 2018, to support the Willamette National Forest. The RMAT team was in-briefed in Springfield, OR, on August 30, 2018, and received a thorough in-brief on current operational status as well as expectations and leader's intent. The in-briefing was attended by the Forest Supervisor, Deputy Forest Supervisor, District Ranger, Forest and District fire personnel.

The RMAT team received a letter of delegation from the Pacific Northwest Region Acting Regional Forester (RF), Dianne Guidry on August 29, 2018. Tracy Beck, Forest Supervisor Willamette NF was assigned as the Agency Administrator (AA) for RMAT.

Between August 30th and September 2nd, RMAT engaged with Ranger District personnel and the IMT to develop situational awareness on current strategies under consideration for the Terwilliger Fire. On September 2nd, RMAT completed the tradeoff analysis for the three alternative strategies for the fire. Attendees included Army Corps of Engineers, local fire district, ODF, Douglas Forest Protection Unit, local Sheriff, IMT members (IC, Deputy IC, Ops, and Safety), Forest Supervisor, Deputy Forest Supervisor, Forest Fire Staff, District Ranger and District FMO.

A closeout with Acting Regional Forester, Dianne Guidry, Regional FAM Director, John Giller, and the RMAT members will be held virtually as soon as a call can be scheduled and after the final report is delivered.

The following people were assigned to the Terwilliger RMAT:

- Team Lead: Becki Heath
- Operations SME: Tim Sexton and Frankie Romero
- Risk Management SME: Tim Sampson and Frankie Romero
- Lead Analyst: Rick Stratton
- Planning and Logistical Support: Sirena Fugitt

RMAT Delegation of Authority

Following are specific expectations included in the Delegation of Authority, for the RMAT from the Acting RF in R6, for this assignment.

"Provide information to the Agency Administrator that will assist in expanding their decision space with respect to incident strategy."

To meet Acting RF expectations, RMAT accomplished the following:

- Provided available RMAT products to the AAs to help inform decision making.
- Provided all work associated with the RMAT deployment electronically to the AA for use at a later date.
- Facilitated Trade-off Analyses (TOA) meeting with AAs and fire staffs to discuss a potential range of strategies, risk assessment to values at risk and responders.
- Documented all aspects of the RMAT deployment to the Terwilliger Fire in a final document that will be provided to the AA, the Forest Supervisor, and Regional Forester and Staff (Providers of the Delegation of Authority).
- Provided AA copies of analytics, and assessments completed for the incident.

"Create time and space for robust discussions around appropriate strategy and how risk management principles can be applied to better inform decisions and produce more positive outcomes."

To meet the Acting RF expectation, RMAT accomplished the following:

- Specialists from RMAT including Operations, Risk Management, and the Lead Line Officer, met formally at least three times with the AAs, as well as informally with individuals from the Forest and the IMT multiple times over the course of the assignment on individual aspects of this objective.
- RMAT members and AAs from Willamette NF engaged in comprehensive discussions around prioritized Values at Risk (VAR), and consequences of the fire impacting those VARs.
- RMAT facilitated a discussion with the AA and IMT on the relative risk to firefighters associated with each strategy evaluated. These discussions focused on how the strategies differed in terms of the number of individuals

engaged, the duration of the engagement, and the characteristics of the hazards to which they would be exposed.
- AAs, District Ranger and Fire and Aviation Staff made themselves available for frequent interaction with the RMAT. The AA ensured the RMAT was introduced to the IMT and that the IMT understood RMATs intent was to assist the AA in ensuring risk-informed quality decisions.

"After the departure of RMAT, provide me with feedback on what went well and what needs improvement in this process."

- A closeout call will be scheduled to brief the Acting RF and Regional Fire Director on outcomes of the assignment.
- This final document will be shared in advance of the closeout call.

Operations

RMAT Operations SMEs were able to attend the close-out for Sinclair's IMT2, and this provided an ideal situation for understanding the overall fire situation and the ongoing strategy for managing the fire. Following the closeout, the IMT Operations personnel met with the RMAT Operations SMEs and provided detailed information on operations plans that had been considered and their judgment on the range of strategies that RMAT might consider for analysis.

Ed Hiatt (NW Oregon Interagency Fire Management Fire Staff) and Eric Johnson (Assistant NWOFM Fire Staff) were also helpful in providing context surrounding interagency cooperation and the important issues for consideration when developing strategies for the Terwilliger Fire.

RMAT Operations and Risk SMEs visited with IC Rick Connell of the incoming IMT2 to discuss current strategy and issues that shaped their selected strategy. In addition, the Operations SMEs met with IMT2 Operations Brett Pargman and others to discuss planned strategy and detailed information on the planned course of action. Existing relationships with the IMT were helpful in quickly explaining the role of RMAT and assuring the IMT leadership that we were there to provide support and not to provide direction. RMAT provided the IMT with Potential Control Lines (PCL) and Suppression Difficulty Index (SDI) products and explained their utility for operational planning.

Potential Control Lines (PCL) and Suppression Difficulty Index (SDI) were used by RMAT Ops to develop three strategic courses of action for evaluation in a tradeoff analysis. The strategies were delineated on operations maps and shared with local fire managers and the IMT. Adjustments to the strategies made based on these discussions. Local Fire Management Officer, Randy Harbick was particularly helpful in refining the strategies.

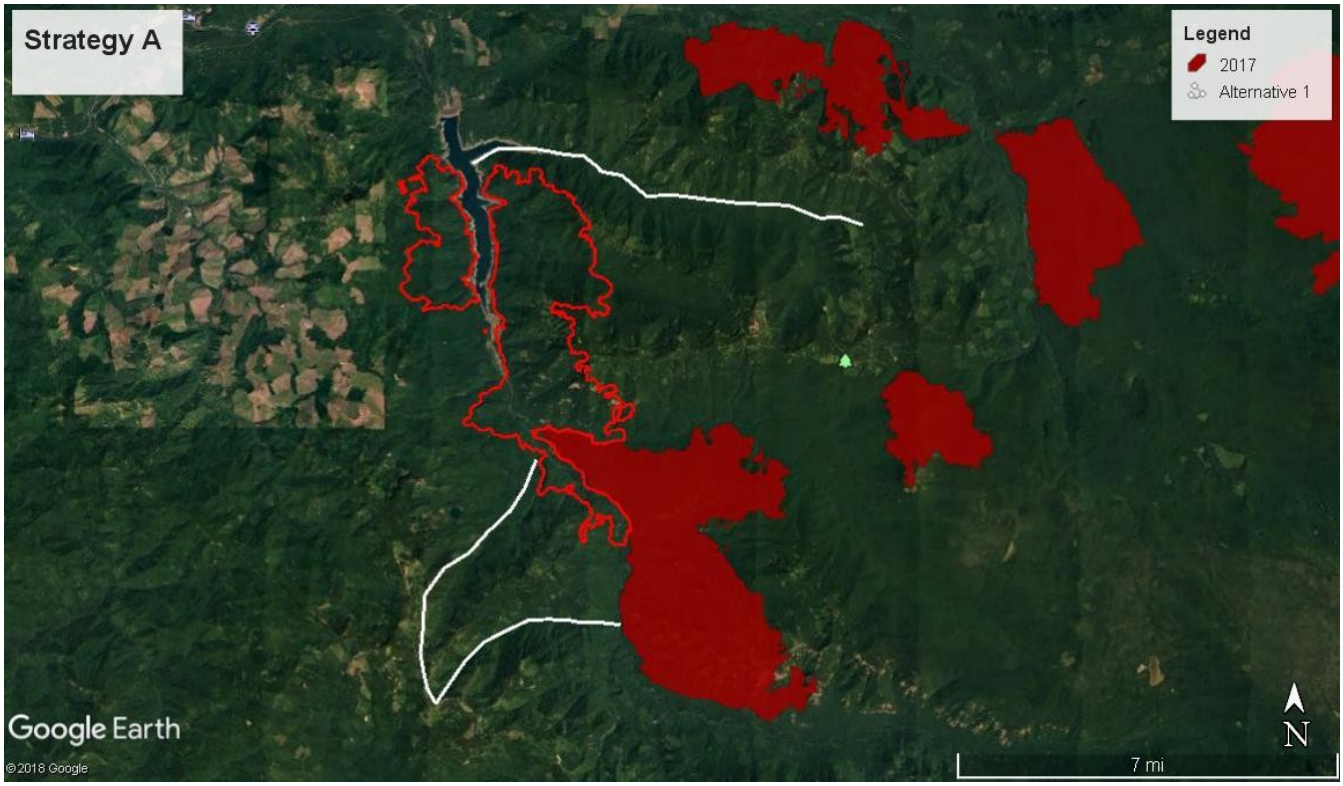
RMAT Operations SMEs and the RMAT Risk SME worked closely in developing the three strategies for the tradeoff analysis. Rick Stratton (RMAT onsite analysts) coordinated access to a variety of analytical tools to help refine the strategies. FSPRo modeling was conducted to determine likely fire spread and how containment lines might protect the public, natural resources, and highly valued assets. Basic fire behavior modeling was also conducted to inform RMAT members on expected flame lengths and the general wind profile throughout the area.

Fire crews had completed much of the containment line on the NW portion of the Terwilliger Fire when RMAT arrived. This area was very close to private timberland and had been designated as the highest priority for containment. Several contingency lines were already in place should the primary containment line fail. Consequently, RMAT decided to omit this area from the analysis.

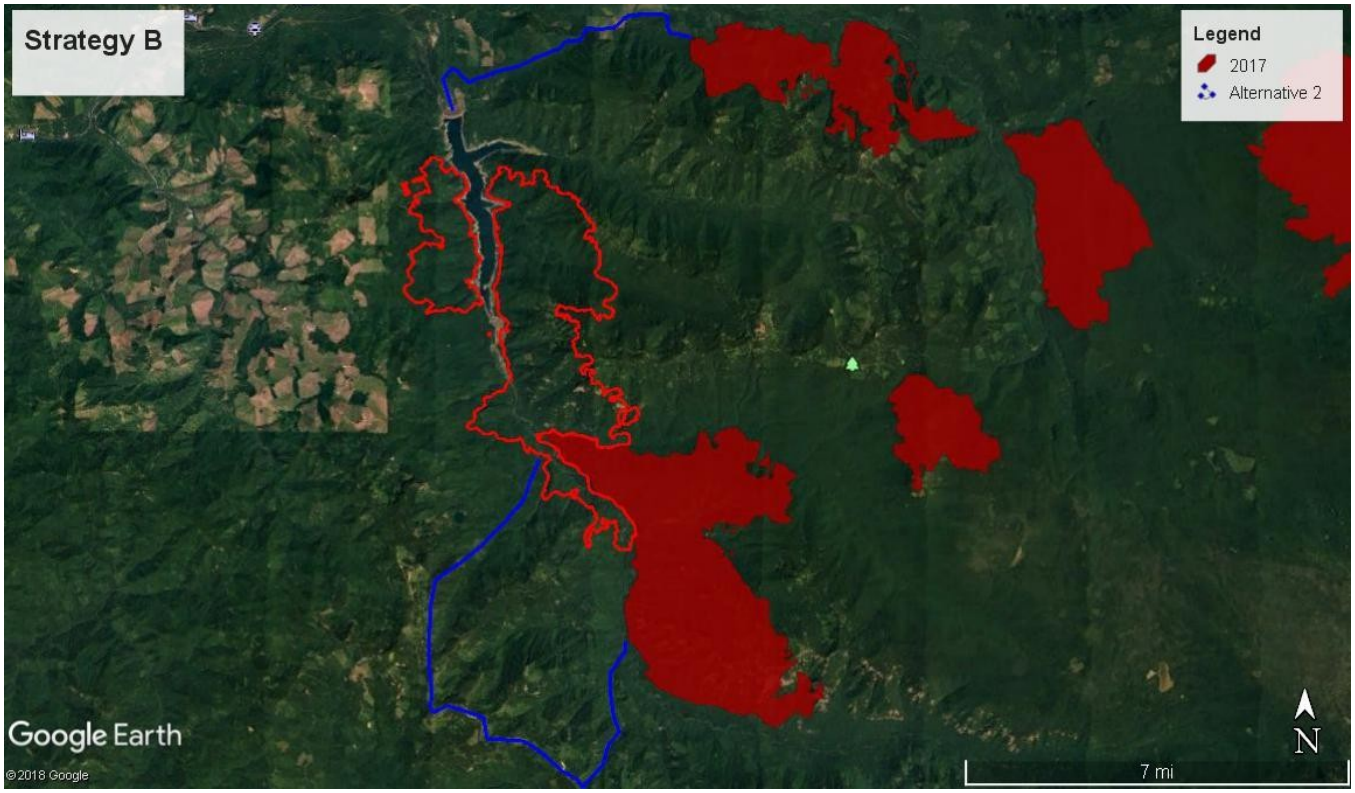
Three strategies were developed: a “no action”, and two action strategies. The two action strategies used road systems with differing amounts of machine and handline for containment locations. The “no action” strategy was developed to display potential damage from the wildfire and why the Agency Administrator might accept the risk to firefighters to prevent the damage.

Strategy A was closest to the fire, but far enough away to provide an opportunity (if the weather remained favorable) for completion prior to the fire reaching the planned line location. The northern portion of Strategy A used Forest Road 1993 from the Cougar Reservoir Dam eastward up the East Fork of the South Fork of the McKenzie River drainage to a point that lay below and to the south of the Avenue Fire (2017). It was assumed that the Avenue Fire had burned at levels sufficient to stop the Terwilliger Fire from spreading to the north.

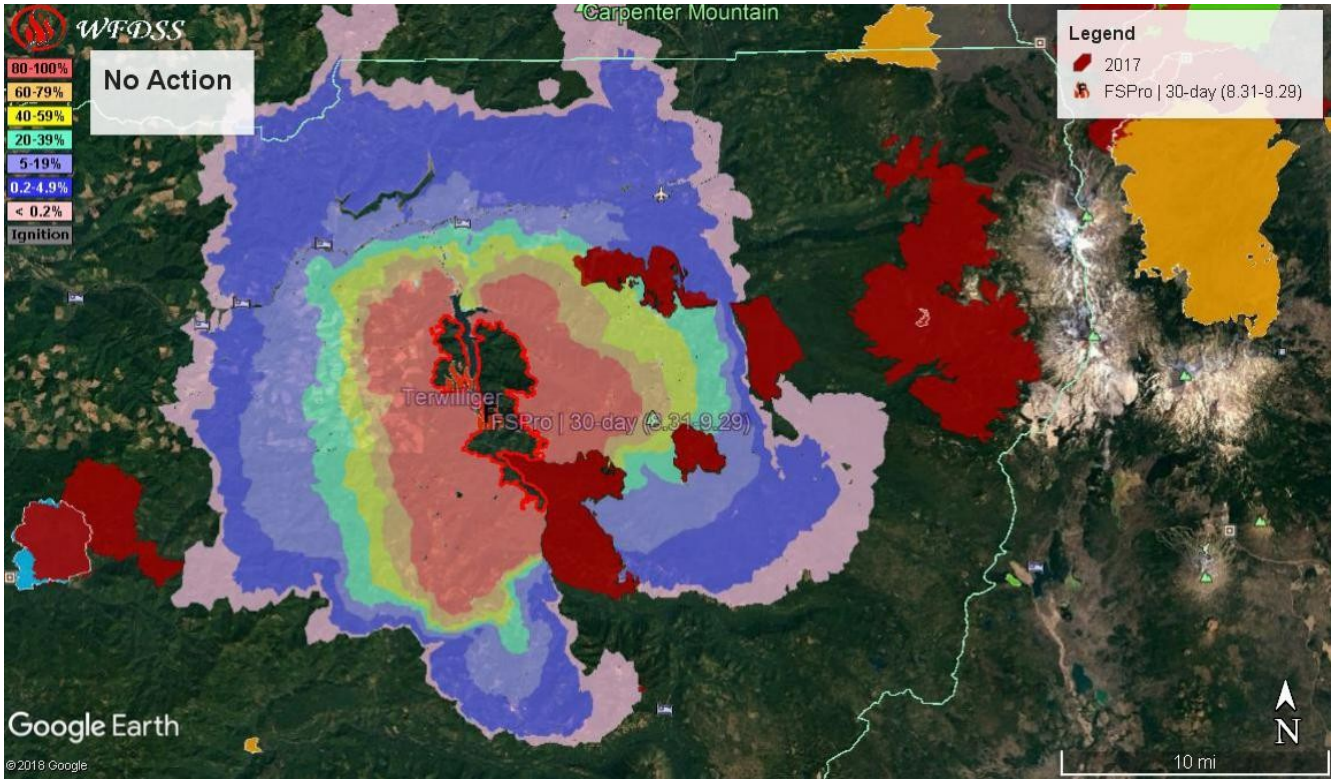
The SW portion of Strategy A used Forest Road 1980 (Hardy Creek Road) south from the fire edge to Forest Road 2618. Machine and handline would be needed to complete the containment lines back to the fire edge along the Starr Creek drainage. Implementation of this strategy would result in the least amount of additional timber and wildlife habitat burned. Total fire size would be about 27,000 acres and would require about 21 days to complete (14 days for the SW portion and 21 for the NE portion).



Strategy B proposed containment lines at farther distances from the active edge of the fire. Locations for these containment lines were based much more heavily on outputs from the SDI and PCL tools. The northern containment line used a system of Forest spur roads and machine line starting from the east side of the Cougar Reservoir dam north and then east to the north of MacDuff Mountain connecting to the Avenue Fire (2017).



Strategy C is the “no action” strategy. The image below displays an FSPRo fire model “run” that predicts the likelihood of the Terwilliger Fire reaching various portions of the landscape outside of the current fire perimeter if no action was taken to stop fire spread.



Firefighter Strategic Risk Assessment

The intention of the firefighter risk assessment is to compare how the evaluated strategies differ in terms of the relative risk to firefighters. The Firefighter Strategic Risk Assessment process attempts to summarize both the quantity and quality of firefighter exposure in order to provide a relative comparison of risk between proposed strategies. To do this, the Firefighter Strategic Risk Assessment utilizes estimates of 1) the number of people by resource type (e.g. crews, engines, fixed-wing aviation, etc.); 2) the duration that individuals will be engaged in a specific activity (e.g. direct line construction, burnout, mop up, etc.); and 3) the characteristics of the primary hazards of that activity. Broad categorical hazards are identified for each activity and notes are associated with how the different strategies vary in terms of probability and severity/consequence of those hazards. Based on the number of people engaged, duration of exposure, and the characteristics of the hazards associated with each activity a comprehensive subjective Risk Assessment Code (RAC) was established for each strategy ranging from Negligible-RAC 5 (green), Minor-RAC 4 (blue), Moderate RAC 3 (yellow), Serious RAC 2 (orange), and Critical RAC 1 (red). It is important to note the person-days required to implement a specific strategy are simply best estimates and are intended to show relative difference in resource commitments across strategies; they do not represent absolute numbers of resources required.

		Severity/Consequences			
		Catastrophic	Critical	Significant	Minor
Probability	Frequently	Critical 1	Critical 1	Serious 2	Moderate 3
	Likely	Critical 1	Serious 2	Moderate 3	Minor 4
	Occasional	Serious 2	Moderate 3	Minor 4	Negligible 5
	Rarely	Moderate 3	Minor 4	Negligible 5	Negligible 5

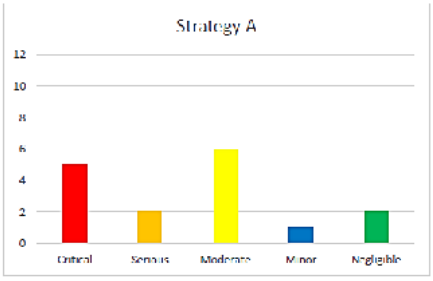
The primary intent of this exercise was to demonstrate how strategies differ in terms of the amount of exposure or risk to firefighters (shown in person-days) and the probability and severity/consequence of the most serious hazards occurring. Fundamental to this comparison is recognizing that the least risk strategy is not necessarily the most appropriate. Obviously the least risk is to not engage a wildfire, however, that may not be a feasible option in many cases due to the risk to values. By examining how firefighter risk varies over alternative strategies we can compare how additional firefighter risk relates to meeting the objectives established through the Values at Risk Assessment. If a strategy that has higher firefighter risk is preferred to a strategy with the lower risk it is implied that the improvement in achieving outcomes is worth the additional risk to firefighters.

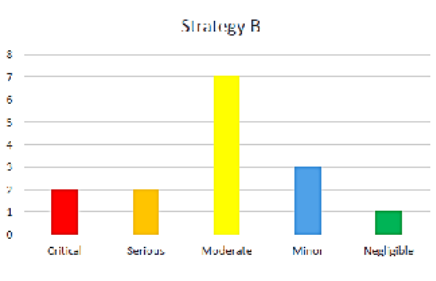
The local district FMO from the McKenzie RD and the Team Safety Officer on Northern Rocky IMT 4 assisted in assigning the hazards and probability that highlighted the severity shown

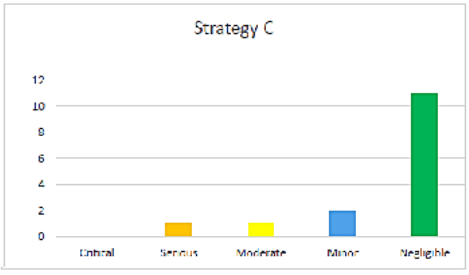
below for each activity. Utilizing local knowledge from the DFMO and an IMT member that's been focusing on operational and real-time risk management on the incident provided a more accurate description of these severity ratings. Below is the Firefighter Strategic Risk Assessment completed for the Terwilliger Fire.

Resource	Activity	Strategy A	Tight Direct/Indirect 21 day	Strategy B	Direct/Indirect 14 days	Strategy C	No Suppression Action
		Person Days	Notes	Person Days	Notes	Person Days	Notes
Crews	Direct Line Construction	800	8 crews X 5 days	500	5 crews X 5 days		Not applicable
Crews	Firing Operations	200	2 crews x 5 days	420	3 crews x 7 days		Not applicable
Crews	Holding/Mop-up Operations	2400	12 crews x 10 days	3000	15 crews x 10 days		Not applicable
Crews	Post Fire Road Safety Midigation	1800	3 crews x 30 days	2700	3 crews x 45 days	2700	3 crews x 45 days
Crews	Road Prep	500	5 crews x 5 days	1120	8 crews x 10 days		Not applicable
Engines	Hiring Operations	75	5 engines x 5 days	147	7 engines x 7 days		Not applicable
Engines	Holding/Mop-Up Operations	450	15 engines x 10 days	1080	18 engines x 10 days		Not applicable
Engines	Patrol	480	8 engines x 20 days	720	12 engines x 20 days		Not applicable
Engines	Structure Protection		Not applicable		Not applicable	270	3 engines x 30 days
Heavy Equipment	Post Fire Road Safety Midigation	720	12 Heavy Equipment x 30 days	1350	15 Heavy Equipment x 45 days	1350	15 Heavy Equipment x 45 days
Heavy Equipment (logging equipment)	Road Prep	400	12 Heavy Equipment x 10 days	784	15 Heavy Equipment x 14 days		Not applicable
Heavy Equipment	Line Construction	120	6 Heavy Equipment x 5 days	56	4 Heavy Equipment x 7 days		Not applicable
Aviation	Fixed-wing	14	1 Air Attack x 14 days	14	1 Air Attack x 14 days	14	1 Air Attack x 30 days
Aviation	Aerial Ignition		Not applicable	4	1 Helicopter x 2 days		Not applicable
Aviation	Rotor	112	4 Helicopters x 14 days	112	4 Helicopters x 14 days		Not applicable
Total person days	Person days: Driving, Infectious Disease, Fatigue, Smoke Exposure...	8071		12007		4334	

Strategy A		Strategy B		Strategy C	
Critical	5	Critical	2	Critical	
Serious	2	Serious	2	Serious	1
Moderate	6	Moderate	7	Moderate	1
Minor	1	Minor	3	Minor	2
Negligible	2	Negligible	1	Negligible	11







Below is the strategic risk summary for the Terwilliger fire that was developed to display during the tradeoff analysis exercise. The intent is to summarize the risk assessment and compare the 3 strategies. It highlighted total personnel days, miles driven, miles of fireline (mechanical and hand) and miles of road preparation for potential firing. The summary also highlights and challenges establishing effective controls for each. Many of the comments that are in this summary were conversations that took place around risk to the firefighter and the challenges of establishing effective controls.

Strategic Risk Summary					RMAT
Incident Name:	**Terwilliger**			**Prepared:**	**9/1/2018**
Strategy A	**Tight Direct/Indirect**	**Total Acres 27,000**		**Incident duration 21 days**	
		Initial Risk Level		**Total personnel days 8,071**	
Hazards		*Likelihood*	*Severity*	*Outcome*	**Comments and challenges establishing effective controls.**
Driving: This will result in 191,000 miles for our fire personnel. Aviation: This Strategy is estimated to take 126 total aviation personnel days to accomplish. Mop up: Due to the fuel type this estimates time is 2850 personnel days to complete mop up. Fire line (hand and mechanical) The estimated number of road prep is 9 miles to be prepared for firing. An additional 4 miles of dozer and hand line will be required for this option.		Occasional	Catastrophic	Serious	Strategy A utilizes a road system FS 1993 on the NE side. One challenge to implement effective controls is this road system is in a drainage bottom that could pose holding challenges. Depending on the fire behavior characteristics when the fire moves off of the slope will depend if this alternative is a safe and effective option. Strategy A on the SW side is on and off road systems. Fire Personnel working off the road systems will add response time to medical personnel reacting to any injury on the line. This is a discussion point being this ground is steep and has big timber with multiple gravity hazards.
Strategy B	**Direct/Indirect**	**Total Acres 40,000**		**Incident duration 14 days**	
		Initial Risk Level		**Total personnel days 12,007**	
Hazards		*Likelihood*	*Severity*	*Outcome*	**Comments and challenges establishing effective controls.**
Driving: This will result in 155,000 miles for our fire personnel. Aviation: This strategy is estimated to take 130 total aviation personnel days to accomplish. Mop up: Due to the fuel type this estimates time is 4,080 personnel days to complete mop up. Fire line (hand and mechanical) The estimated number of road prep is 11 miles to be prepared for firing. There will be minimal hand and mechanical lines to implement.		Rarely	Catastrophic	Moderate	This Strategy allows fire personnel to work in an areas that has options for ingress and egress. Strategy B has more effective medical evacuation response for an injured firefighter compared to Strategy A. There is still multiple gravity hazard concerns with this strategy but this is mostly on roads.
Strategy C	**No Action**	**Total Acres 65,000**		**Incident duration 45 days**	
		Initial Risk Level		**Total personnel days 4,334**	
Hazards		*Likelihood*	*Severity*	*Outcome*	**Comments and challenges establishing effective controls.**
Driving: This will result in 2,025 miles for our fire personnel. Aviation: This Strategy is estimated to take 14 total aviation personnel days to accomplish. Mop up: None Fire line (hand and mechanical): None		Occasional	Significant	Minor	Do to the fire weakened gravity hazards adjacent to road systems. There will be personnel days with hand crews and equipment to mitigate gravity hazard before road systems can be opened back up to the public.

On the Terwilliger Fire, the hazards that are prominent for firefighter risk was gravity hazards. The forest stand has big timber and the terrain is steep. This resulted in multiple dead and green trees coming down. Other gravity hazards are also highlighted like rocks and debris rolling on roadways. Example the current IMT shut down fire traffic access to the 19 road due to a crew vehicle that was damaged and multiple near misses fire personnel experienced. Another discussion point was utilizing the ground evacuation map evaluating medical extraction times comparing the different strategies.

Supporting documents that were utilized for the strategic risk assessment were Suppression Difficulty Index (SDI), Ground Evacuation Injury and Illness (GEII), and Firefighter Hazard and

Exposure Map. Intel from the local DFMO and the team safety officer added valuable information that was utilized in the risk assessment.

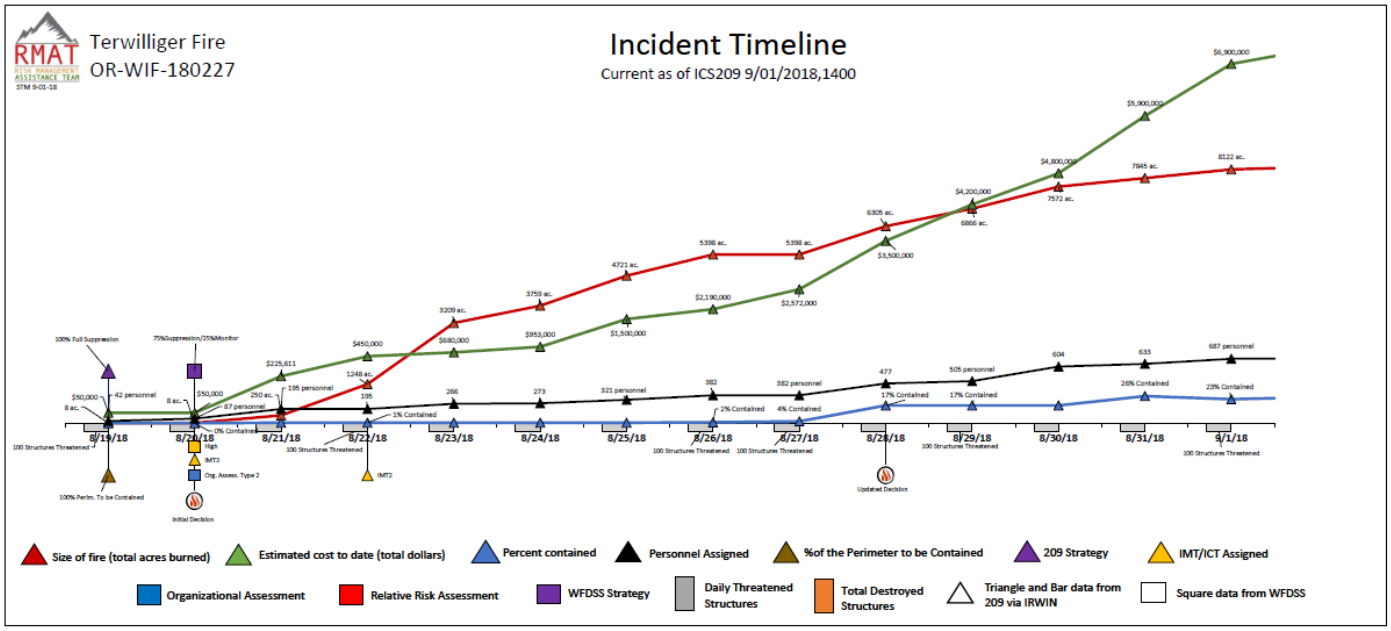
RMAT Analytics and Products

RMAT teams are supported by analysts working onsite and virtually to develop analytics based on research and emerging technologies. These analytics are used by the RMAT to engage AAs and IMTs in a discussion about current and potential strategies, track ongoing incidents, ensure alignment with the AA's intent, and provide additional information in a manner that can assist with establishing and maintaining a common operating picture. The following is a description of the analytics produced by the RMAT, and how they were used on the Terwilliger Fire. Final products and this report will be posted on the RMAT external website: (https://sites.google.com/a/firenet.gov/rmat/rmat-file-cabinet).

Timeline Graphic

The incident timeline is a visual depiction of the history of a fire. The product can be used by incoming teams and resources to get a quick history of the incident and by the unit as a tracking mechanism of what has occurred on the fire. Data are acquired from the IRWIN Observer application and WFDSS. IRWIN ensures the Authoritative Data Source (ADS) is used for each data element.

This timeline was shared with the AA and IMT to provide a history of key elements on the fire to date. This timeline was developed with data through Sept. 1, 2018.

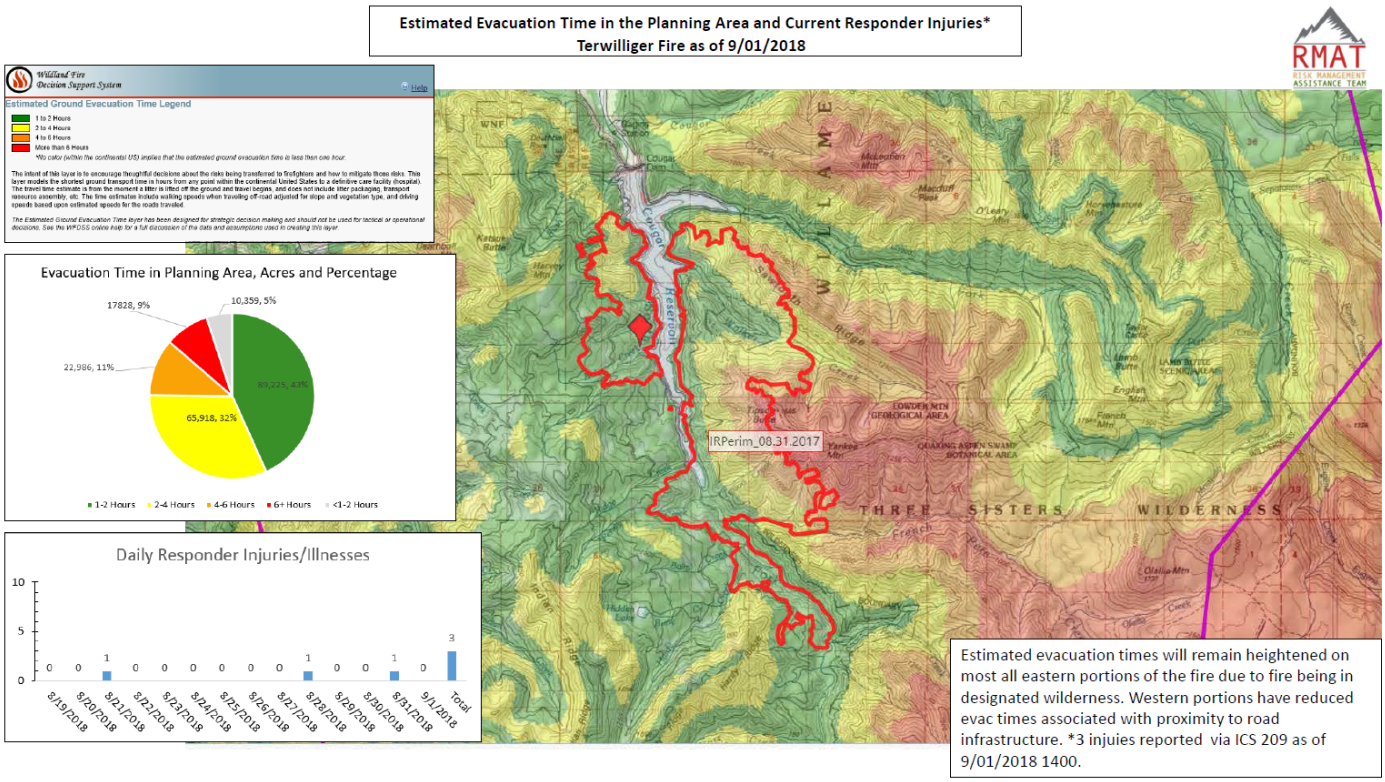


Ground Evacuation Map and Injury/Illness Information

The Estimated Ground Evacuation Map has been designed for strategic decision making and should not be used for tactical or operational decisions. The ground evacuation layer can assist in identifying estimated ground transport time from different locations on a fire to a care facility. The time estimates include walking speeds when traveling off-road adjusted for slope and vegetation type and driving speeds based upon estimated speeds

for the roads traveled. The intent of this layer is to encourage thoughtful decisions about the risks being transferred to firefighters and how to mitigate those risks.

The Ground Evacuation Map was shared with both AA and IMT members. RMAT members utilized this map to help inform the development of the alternative strategies for the Trade Off Analysis and it helped inform the Firefighter Risk Assessment ratings.



Management Direction Alignment Table (MDAT)

One of the products that are provided to the AAs is a Management Direction Alignment Table (MDAT).

The product takes information/data from the Forest Plan, WFDSS (management objectives), a delegation of authority (DOA), Letter of Intent and Incident Action Plans (IAP) to look at incident objectives. The product's intent is to track direction given at various levels and documents to ensure they are in alignment.

The lead line officer assigned to the Terwilliger RMAT presented the MDAT tables and Discussion Point documents to the District Ranger and Deputy Forest Supervisor with responsibility for the fire. The Discussion Point document outlined major, moderate and minor issues related to alignment and is color coded for easy reference back to the MDAT tables. The line officer lead went through a validation process to review all of the forms of direction provided to firefighters in the Terwilliger fire. This review process occurred on August 28th and looked at alignment between the Willamette National Forest Plans, as displayed as management objectives pre-loaded into WFDSS, and the DOA.

The discussion that resulted from the review of the MDAT highlighted the clear relationship between WFDSS objectives and IAP objectives and examined how well the AA intent reflected guidance in the COA, and how well the objectives in the IAP reflected the AA's Intent and COA. The leader's intent letter which accompanied the DOA was well written and provided clear expectations of the team. We noticed that there was a risk of some

conflicting language relative to Wilderness and fire suppression. Also, some of the wildlife, fish and water concerns were not carried into the IAP.

Management Direction Alignment Table

Fire: Terwilliger Fire, ORWIF-180227, 2018

The following table compares the direction in the LRMP via WFDSS Strategic Objectives and Management Requirements, Incident Objectives and Requirements in the WFDSS Decision, Delegation of Authority/Leader's Intent, Course of Action from WFDSS, and Incident Action Plan (IAP). They are grouped by General Category.

Category	LRMP Strategic Objective	LRMP Management Requirement	WFDSS Incident Objectives and Requirements	WFDSS COA	DOA/Leader's Intent	IAP Objectives
Safety/Risk Management			Firefighter and public safety will always be the highest priority over all other incident objectives. Utilize deliberate risk management processes to ensure that incidents responders are only committed to operations where they have the highest probability of success under conditions where important values at risk are protected with the least exposure necessary.	Take advantage of natural barriers, trails, roads, weather conditions, and available resources to contain fire to the smallest possible size, consistent with firefighter and public safety considerations. Full Suppression utilizing a combination of direct attack, indirect attack, and point protection. The strategy used will be dependent on firefighter and public safety and Values at Risk. Monitor the fire as it moves into the wilderness and attempt to utilize the fire scars from 2017 as containment features.	**RISK MANAGEMENT AND EXPOSURE** Utilize risk management tools to provide for the well-being of incident personnel and the public while implementing operational objectives commensurate with values at risk and probability of success. Being mindful of "Life First" principles (Stop, Think, Talk and then Act) is of utmost importance when identifying, evaluating and developing operational strategies and tactics to be balanced with values at risk. The following statement are to provide more context about the purpose of Life First and significantly increase the odds that everyone comes home safe: • Ensure awareness, understanding and support of leader's intent. • Ensure a common understanding of unnecessary exposure exists among agency administrators, commanders, responders, and community leaders. • Consider what actions can be taken within spheres of influence to reduce unnecessary exposure. • Commit to **Stop, Think, Talk…before Acting** to help eliminate unnecessary exposure and increase the odds that everyone comes home.	Incident Response personnel and public safety will always be the highest priority over all other incident objectives. Utilize a deliberate risk management process to ensure that incident responders are only committed to operations where they have the highest probability of success under conditions where important values at risk are protected with the least exposure necessary.

Suppression Difficulty Index (SDI) Map –Experimental Product

Provided by Christopher Dunn (Oregon State University), the SDI is a spatial representation of potential for risk to firefighters tempered by our ability to mitigate that hazard, taking into account potential fire behavior, accessibility, (vehicular and on foot), fire line production rate, and availability of fuel breaks/fuel treatments.

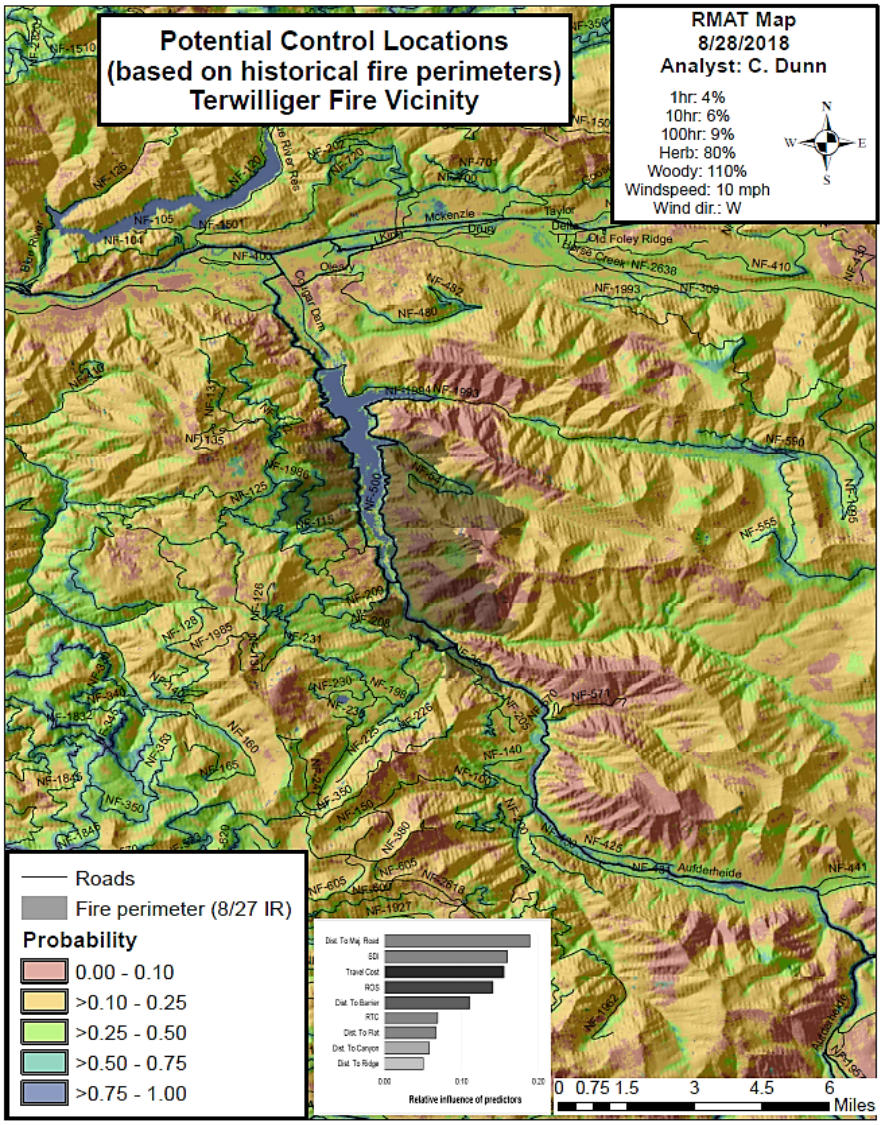
The initial SDI developed for the Terwilliger Fire used a calibrated Landscape File (LCP) from the LTAN to inform the fire behavior modeling needed for SDI. RMAT members provided the SDI to the incoming IMT2 and Operations personnel recognized its utility in selecting places where fire response activities would be easiest or hardest to accomplish. RMAT members also used SDI to help inform their proposed alternative strategies used in the Trade-Off Analysis.

Potential Control Location (PCL) Map – Experimental Product

Also provided by Christopher Dunn (Oregon State University), the PCL shows where there is a high or low potential for fire containment. The product uses historical fire perimeters, slope and SDI to identify conditions appropriate for fire containment on a specific

landscape. The containment probability is designed to identify potential control features for use in containment and assumes firefighting effort is consistent with past fires in the area. It can aid in identifying opportunities and challenges for limiting fire spread across a landscape.

RMAT members provided the PCL to the incoming IMT2 and Operations personnel recognized its utility in selecting places where fire control activities might have the best opportunity of success. RMAT members also used PCL to help inform their proposed alternative strategies used in the Trade-Off Analysis. It was also displayed to help inform participants during the TOA as they contemplated Probability of Success and Consequence of Failure estimates for each of the proposed strategies.



Exceedance Probability Curves & Stacked Bars

Background

Wildfires can cause significant negative impacts to private property, infrastructure, recreation, and natural resources, including water, timber, and wildlife habitat. However, there can be ecological benefits to fire, particularly in areas where assets are absent. Every year individual units, area commands, and regional multi-area commands are challenged with the task of prioritizing resources to protect highly valued resources and assets (HVRAs) and still balancing the benefit of fire. The prioritization process varies among different units and geographic areas, but analyses are generally a-spatial, not quantitative, and frequently do not account for predicted fire behavior or growth.

Exceedance probability (EP) output can be used to compare multiple incidents or show the effect fire has on highly valued resources and assets (HVRAs). The output is displayed in two ways: curves or stacked bars. These products graphically depict the relative benefit and/or loss to HVRAs by a given fire and comparisons among individual fires can be made. A mean conditional net value change (cNVC) by HVRA was obtained from the Pacific Northwest all-lands, quantitative wildfire risk assessment (QWRA). The product is a series of curves and a stacked bar chart by HVRA displaying a net expected loss or benefit. These graphs can provide decision makers with a quantitative metric of potential loss or benefit to help aid in the difficult task of managing a fire.

These products were used during the TOA to inform participants on the expected Consequence and Probability of experiencing that Consequence as the Risk to each of those values were evaluated.

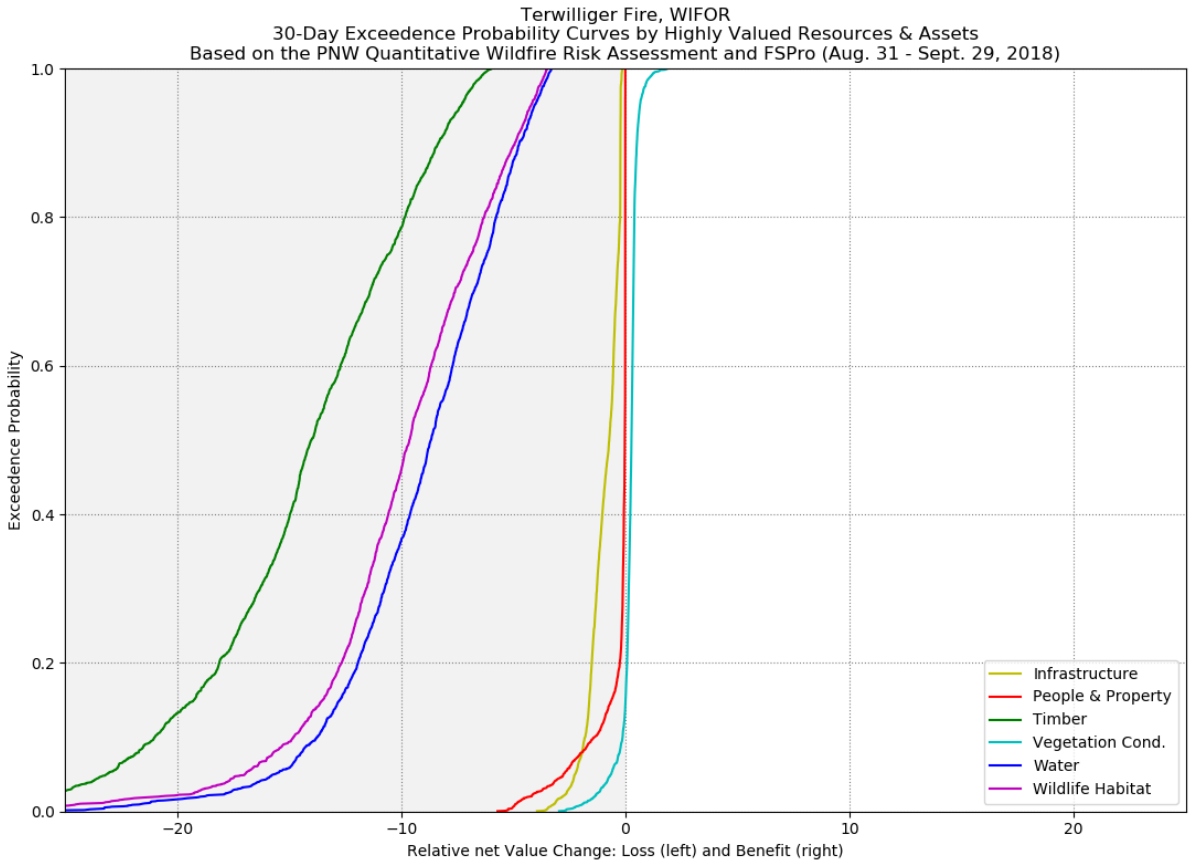
Interpretation

Below are (1) an EP curve, (2) stacked bar, (3) screen capture of the 30-day FSPro run for the Terwilliger Fire, ORWIF (Aug. 31 – Sep. 29), and (4) the list of the HVRAs from the PNW QWRA.

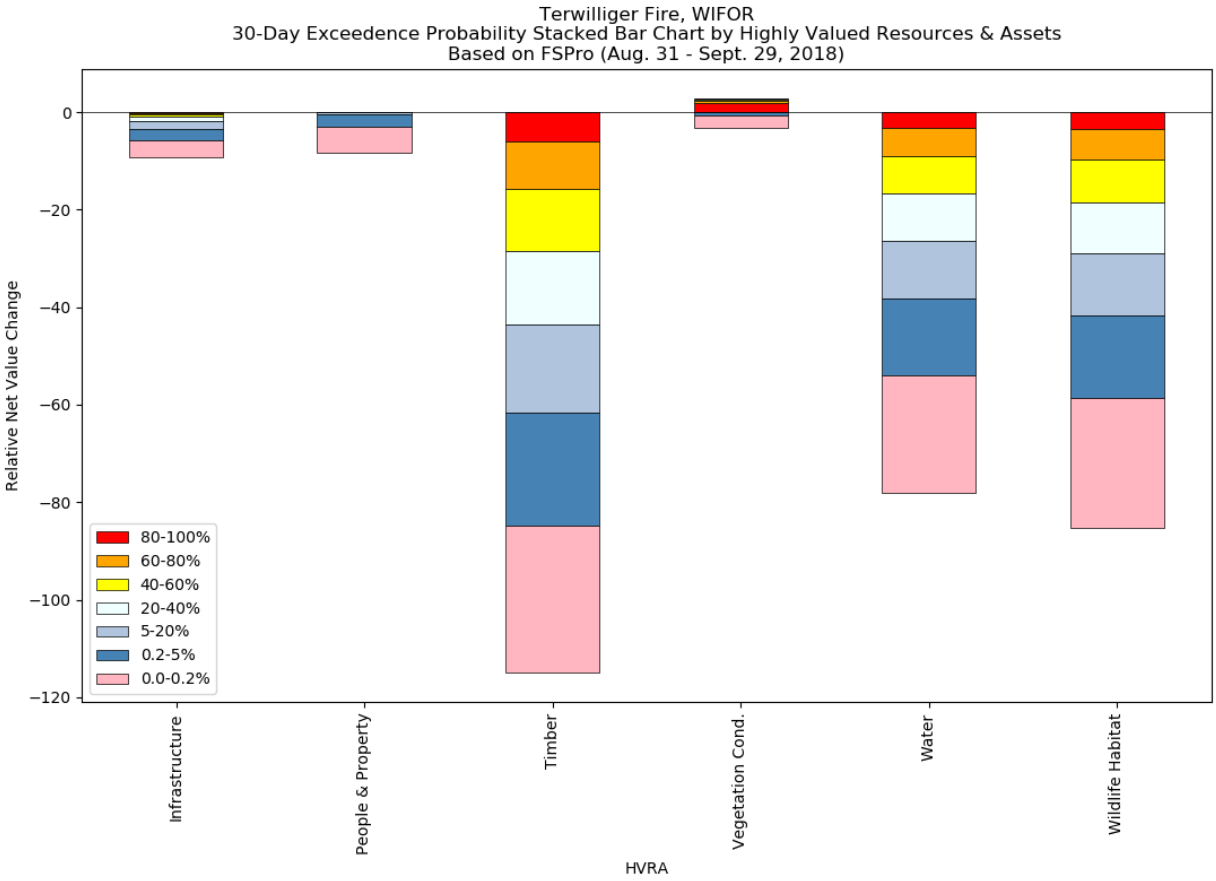
(1) Using the EP curve graphic, find the 0 line (center). The lines represent HVRA categories. Expressed as a relative net-value-change, curves on the right are positive (a benefit); curves on the left are negative (a loss). The further you go to the right or left, the greater the benefit or loss.

The best place to start is at the top and represents the burnable fuels surrounding the ignition. Vegetation condition is the only HVRA group that shows a benefit (mild). However, as the FSPro bands reach outward this turns to a mild loss around the 40% mark (i.e., there is a 60% chance over the next 30 days that there will be a benefit to vegetation condition).

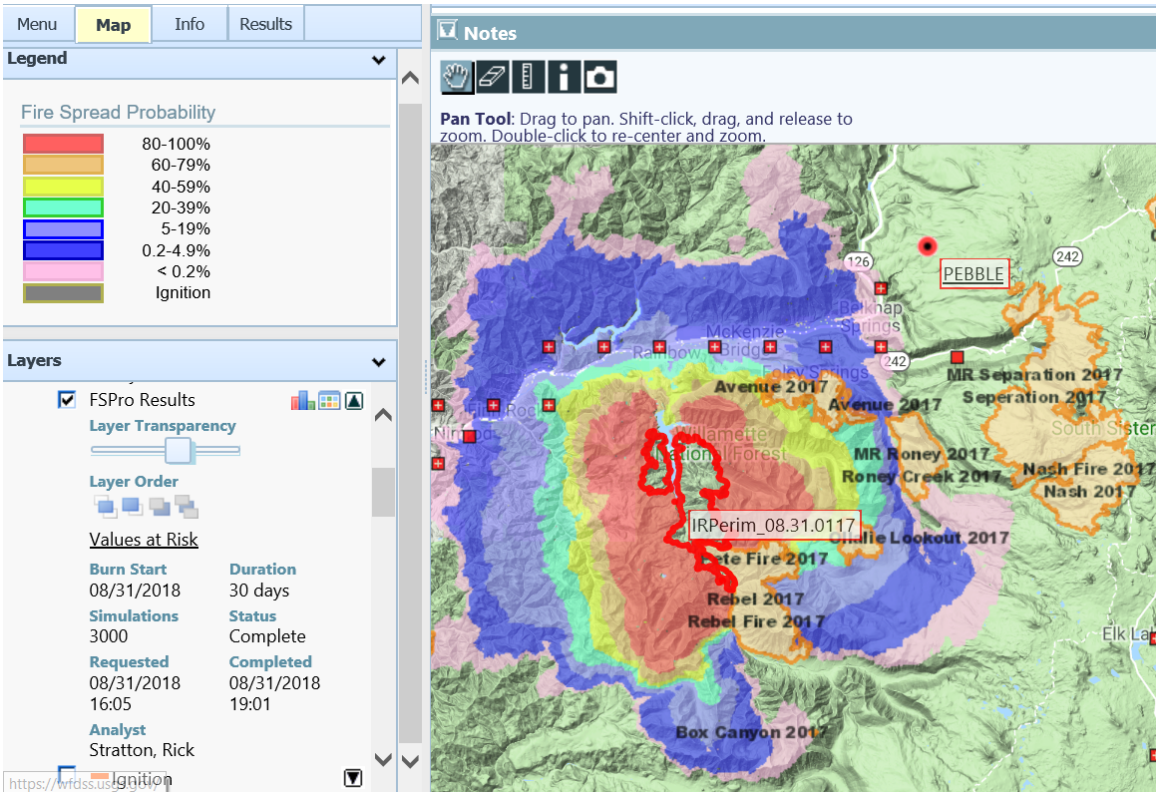
People and property and infrastructure show a mild loss. Water, which includes municipal intakes and post-fire erosion, and wildlife, show a moderate loss. Wildlife habitat of concern includes a northern spotted owl, bull trout, and Chinook salmon. Merchantable timber, which includes private, is the HVRA category that shows the greatest potential for loss over the next 30-days, barring suppression.



(2) The stacked bars are another way to display the data—a way to see into each curve. Bars stacked upward are a benefit; bars that point downward are a loss. You will note the stacked bar colors correspond to the FSPro probability bands. The HVRA category with the highest probability—in red—is timber (a loss).



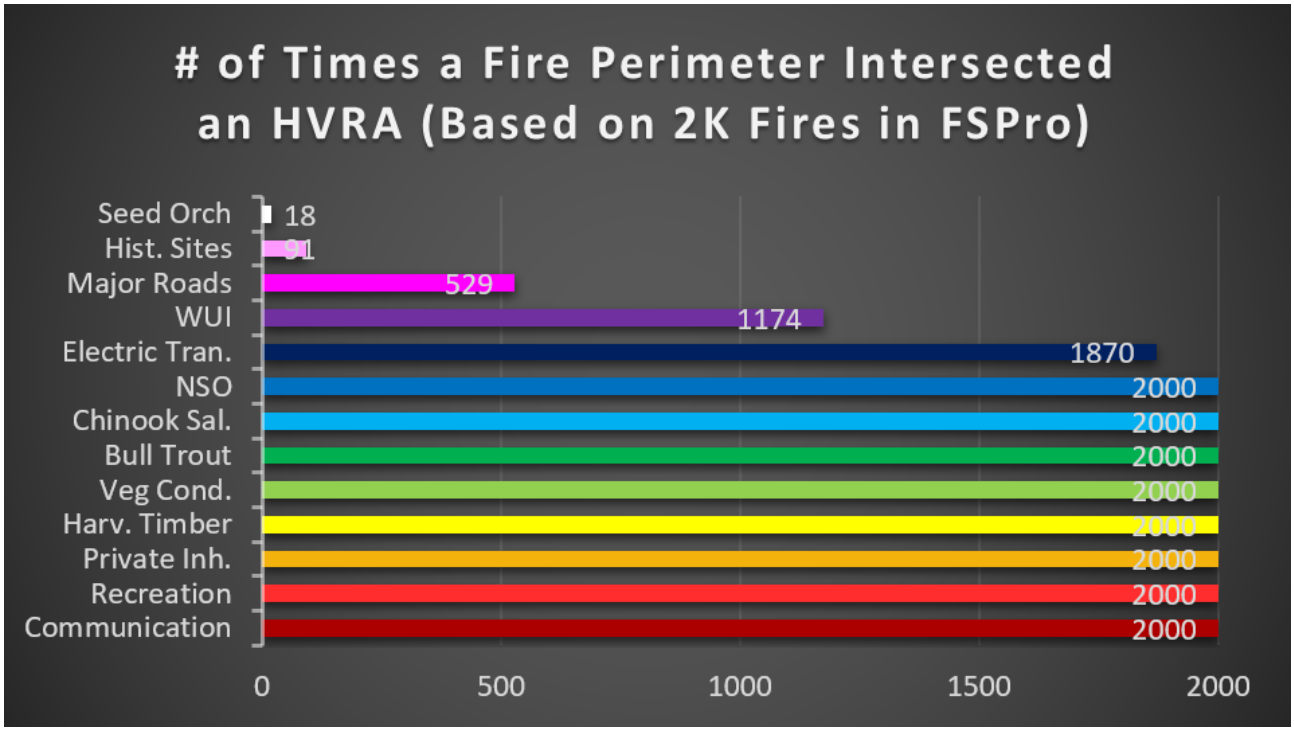
(3) 30-day FSPro by Rick Stratton (Aug. 31 – Sep. 29).



(4) Highly Valued Resources and Assets and sub-HVRA identified for the Pacific Northwest Quantitative Wildfire Risk Assessment and associated data sources (from the assessment report from Pyrologix LLC, dated April 10, 2018). The horizontal bar chart, at the bottom of the page, highlights the number of times a fire in FSPro encounters an individual HVRA or HVRA category.

HVRA & Sub-HVRA	Data source
Infrastructure	
Electric transmission lines – high & low voltage	Electric Power Transmission Lines extracted from the Homeland Security Infrastructure Program (HSIP) database.
Railroads	Railroad features extracted from the Homeland Security Infrastructure Program (HSIP) database.
Roads – Interstates and State highways	Interstates and highways extracted from the Homeland Security Infrastructure Program (HSIP) database. Removed smaller roads (SHIELD_CL=0) from highways.
Communication sites and cell towers	Communication sites, towers, and antennas and cell towers extracted from the Homeland Security Infrastructure Program (HSIP) database.
Seed orchards	Extracted from the Pacific Northwest Region Corporate database to represent seed orchard assets across the Region.
Sawmills	Wood Product Manufacturing Facilities extracted from the Homeland Security Infrastructure Program (HSIP) database.
High and low developed rec sites	Recreation sites/structures mapped by USFS, USFWS, NPS, BLM, ODF, and DNR and including state, county, and local parks and campgrounds. High vs. low investment level assigned based on dataset attributes.
Ski Areas	OR and WA ski area boundaries, digitized outer edge and infrastructure using Google Earth imagery
Historic buildings	Historic buildings as recorded by the National Register of Historic Places
People and Property	

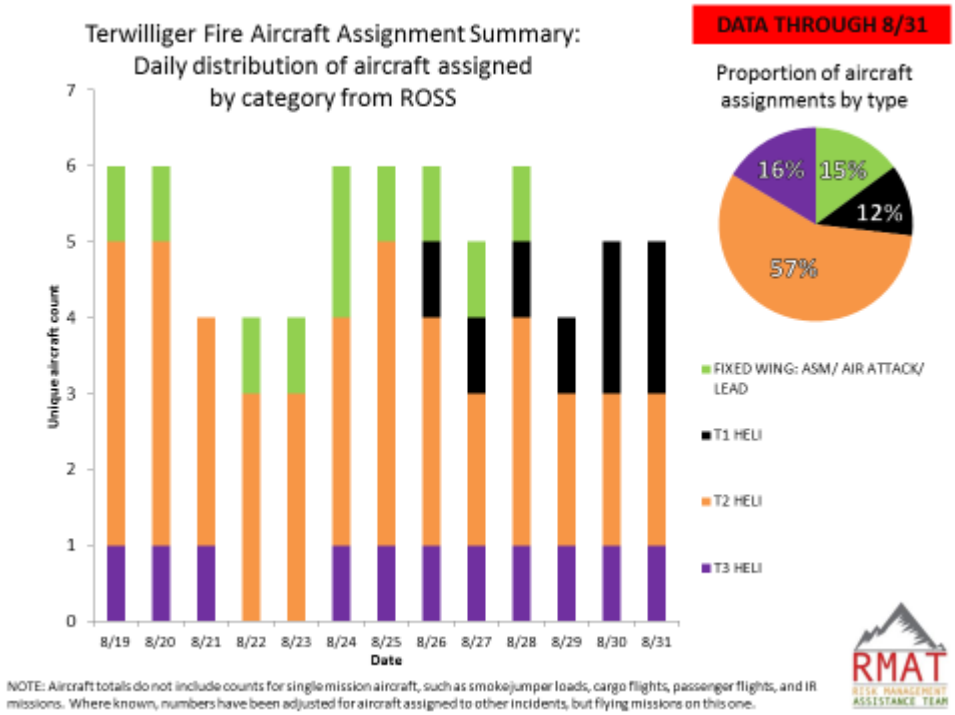
Where People Live (WPL) by density class	Housing density classes as developed by the West Wide Wildfire Risk Assessment project
USFS Private Inholdings	Private inholdings on USFS lands extracted from the Basic Ownership layer by querying "NON-FS". NPS lands were removed from the NON-FS lands before including in this dataset. Refined to private ownership using BLM Ownership (OWNERSHIP_POLY) and BLM Surface Management Agency (BLM_SMA_FS_update).
Timber	
USFS Active Management and NWFP Matrix Lands	A Spatial Database for Restoration Management Capability on National Forests in the Pacific Northwest USA, (Ringo *et al.*, 2016). Matrix lands in OR and WA from Northwest Forest Plan.
Tribal Owned/Colville Reservation Commercial Timber	American Indian/Alaska Native/Native Hawaiian (AIANNH) Areas Shapefile from U.S. Census Bureau as Tribal ownership overlay along with Colville Reservation Commercial forestland
Private Industrial	Privately owned, industrial timber lands extracted from the Atterbury Consultants ownership maps for Oregon and Washington (selected attributes containing IFPC, REIT, and TIMO)
BLM Harvestable/Potential	Harvest Land Base from the ROD for western OR, O&C lands, Coos Bay Wagon Rd, Public Domain lands, and the BLM-owned polygons from the E. WA Resource Management Plan.
State-owned for Oregon and Washington	State-owned lands in OR and WA excluding State Parks, State Fish and Wildlife lands, and Parks and Recreation lands.
Fire Regime Groups 1,3,4/5	R6 Forest Structure Restoration Needs Update Analysis – (DeMeo *et al.*, In Press)
Size classes <10in., 10-20in., >20in.	R6 Forest Structure Restoration Needs Update Analysis – (DeMeo *et al.*, In Press)
Vegetation Condition	
Seral state departure by FRG group	R6 Forest Structure Restoration Needs Update Analysis – (DeMeo *et al.*, In Press)
Watersheds	
Watersheds	Washington Drinking Water System Boundaries for watershed boundaries and surface water intake locations Oregon Surface Drinking Water Source Areas and intake locations from EPA Safe Drinking Water Information System (SDWIS)
Erosion potential	Developed by USFS Remote Sensing Applications Center (RSAC)
Wildlife	
Marbled Murrelet	U.S. Fish and Wildlife Service, Endangered Species Program, ECOS Joint Development Team
Northern spotted owl	Predicted habitat suitability map (Glenn *et al.*, 2017)
Sage grouse habitat	Wildland Fire Decision Support System (WFDSS) - 2015 greater sage grouse (GRSG) Land Use Plan (LUPs) Allocations
Resistance/Resilience class	USDA - Natural Resources Conservation Service, Index of Relative Ecosystem Resilience and Resistance across Sage-Grouse Management Zones
Bull trout	StreamNet Generalized Fish Distribution, Bull Trout (January 2012)
Chinook salmon	U.S. Fish and Wildlife Service, Endangered Species Program, ECOS Joint Development Team
Coho salmon	U.S. Fish and Wildlife Service, Endangered Species Program, ECOS Joint Development Team
Steelhead trout	U.S. Fish and Wildlife Service, Endangered Species Program, ECOS Joint Development Team
Redband trout	Non-anadromous Redband Trout (RBT) Range-wide Database - ODFW
Coastal cutthroat trout	StreamNet Generalized Fish Distribution, Coastal Cutthroat Trout (January 2012) -
Lahontan cutthroat trout	StreamNet Generalized Fish Distribution, Lahontan Cutthroat Trout (January 2012)



Aviation Use Summary

Provided by Crystal Stonesifer (USFS Rocky Mountain Research Station) the RMAT uses emerging technologies and existing federal data systems to summarize and map aviation actions in fire suppression. Products included in the Aviation Use Summary are intended to enhance decision makers' abilities to quantify and track aviation exposure through time, including the ability to account for accident expectation associated with relatively minor levels of repeated aircraft use over a long duration incident. These products can initiate important conversations highlighting thoughtful consideration of the associated risk and intended benefit of every management decision that results in exposure to firefighters, whether they are ground or aerial based assets. These products can also be used to improve communication between different levels of fire management and to highlight potential areas of risk transference between ground and aviation.

For this particular fire, there had not been any retardant use to date and only limited helicopter use, so in this instance the AUS was somewhat informative but not as enlightening as we often see for fires that have significantly more aviation use.



Terwilliger Fire Aircraft use summary

Aircraft use has been modest in terms of # of aircraft assigned.

- 3-5 helicopters assigned per day since 8/19.
- 1-2 fixed wing aircraft (Air attack/ASM) per day up to 8/28.
- A drone incursion into the TFR on 8/26 temporarily grounded aircraft.
- Several aircraft provided support to a new fire on the local district (8/30).

No mapped drop data is available for this fire, though numerous drops have been made.

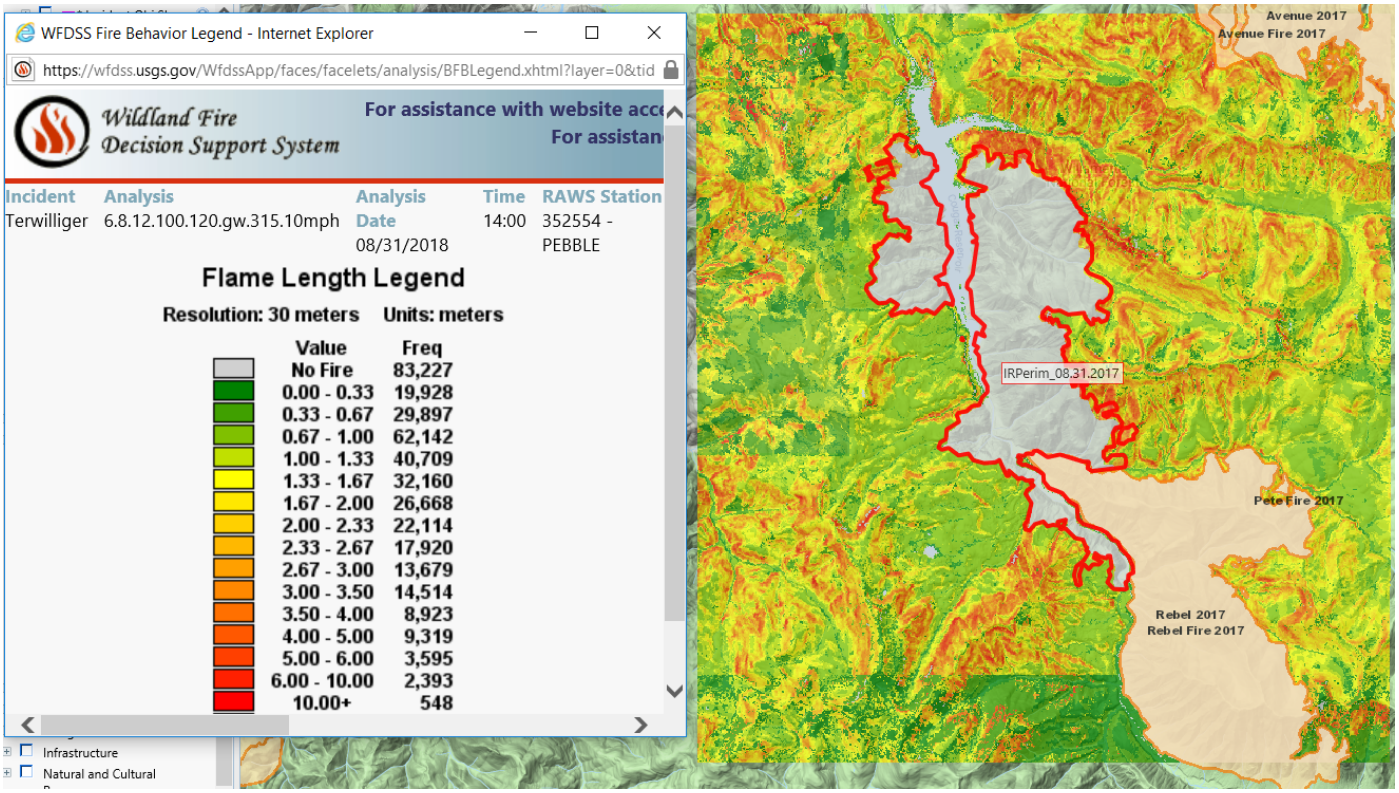
- There have been no air tanker drops on the fire.
- Nationwide, only 26 helicopters are on contract to provide this data.
- None of those 26 have been assigned to this fire.
- Public information releases have estimated 50,000 gallons dropped on 8/28 and 60,000 gallons on 8/29.

DATA THROUGH 8/31

RMAT
RISK MANAGEMENT ASSISTANCE TEAM

Basic Fire Behavior Run

A basic fire behavior run was completed in WFDSS to show gridded winds, flame length, rate-of-spread, and hauling chart information. This information was used by the RMAT in the TOA to look at effects to timber sales and placement of potential control lines.



Trade-off Analysis (TOA)

The intent of the TOA is to analyze a range of potential response strategies that are both realistic and will meet the incident objectives. It is not intended to reach a conclusion or decision, rather it is intended to stimulate discussion and inform a decision. Each proposed strategic alternative is evaluated for the purpose of relative comparison for the following elements:

- Risk to highly valued resources and assets (aka “values at risk”)
- Risk to firefighters
- Probability that each strategy will succeed
- The consequences of a strategy failing

The line lead met with the Deputy Forest Supervisor, the District Ranger and the AAR for ODF to discuss and validate Values at Risk. We reviewed the values presented in the DOA/AA letter of intent and then discussed additional concerns, like smoke and duration of the event as well as natural resource values such as T&E species, water quality, and recreation. The list was refined to identify those critical values that would influence the

AA's to consider a change in their selected response strategy. First and foremost, it was clear that life is the most important value to be protected. Next in line, the critical values at risk identified by the AA were:

1. Private Commercial Timber
2. Private Property
3. Federal Commercial Timber
4. Other Natural Resource Values such as T&E Species, Recreation Opportunities, and Water Quality
5. Public Health and Safety including a direct threat to persons from fire and smoke/air quality

To prepare for the TOA, a discussion was held between the RMAT and the forest to determine the most appropriate focus for conducting the TOA including where and how many strategies would best meet the forest concerns and interests. It was determined that the Northwest portion of the fire closest to the Forest boundary where a strategy of direct or close indirect control was being employed would continue to favor this strategy regardless, so this area did not lend itself to consideration of competing alternatives. The two areas that did lend themselves to a comparison of alternative strategies were the Southwest and Northeast sides of the fire where continued fire spread could require a decision between use of the closest available control features vs the best available control features.

RMAT members through conversations with local fire management and members of both the outgoing and incoming IMT2 formulated three potential wildfire response strategies for consideration. The three fire response strategies developed for the TOA are described as follows:

Alternative A: Tight Direct/Indirect

This strategy emphasizes keeping the fire as small as practical preferring direct attack but recognizes that effective firefighting and safety concerns often require indirect attack. On the southwest side of the fire, the general preference is to control the fire between Hardy Cr. to the north, S. Fk. McKenzie River to the east, Starr Cr. to the south and finding the most logical point to halt the westward spread somewhere along Hardy Ridge up to but hopefully before the junction of FSR 1980 & FSR 2618. Existing roads would be used as the primary lines with mechanical firelines being constructed whenever feasible and use of handlines when necessary. To the northeast, the general preference is to use machinery to prep FSR 1993 for possible holding action between the road and the bottom of the East Fk. of the McKenzie River up until some point below the 2017 Avenue fire in order to check any further spread to the north. This strategy does not propose to take any action to halt the easterly spread, instead relying on a season-ending event to eventually halt any continued spread to the east.

<u>Expected Peak Resource Commitment:</u>

Approximately 600 personnel & 5 Aircraft - similar to the current organization. Heavy reliance on mechanized equipment to prep roads and build containment lines; Requires specialized equipment (Feller/Buncher); hand crews to build fireline, but mostly needed to perform burn out, holding, mop-up and post-containment road safety mitigation (hazard trees); requires small but intensive air support primarily from rotor-wing (T2 & T1 Heli) for direct crew support during burn out and holding.

<u>Expected Duration/Size:</u>

Southwest side: Approximately 14 days to complete fire line construction, burn out and holding actions with additional 7 days for mop-up/repair; Northeast side: Approximately 21+ days following fire along the E. Fk. as it moves down slope with monitoring of easterly spread continuing well into early October. Assuming control actions work and FSPro projections are accurate, there is a 40-59% chance that the final fire size could reach somewhere around 27,000 acres.

Alternative B: Extended Indirect/Direct

This strategy favors indirect control emphasizing the use of existing roadways and natural fuel transitions to facilitate effective/efficient control and mitigate firefighter risk. The emphasis of this strategy focuses on select existing control features that make fireline construction less taxing and time-consuming and may accept some limited impacts to values if there can be measurable gains made to reduce risk to firefighters and/or increasing the probability of successful fire control. It uses FSR 2618 & FSR 1980 as the primary control features along the Southwest. To the northeast, it uses the line identified by IMT's as a viable connection between S. Fk. McKenzie up to the Avenue fire.

Expected Resource Commitment:

Similar to the current organization. Heavy reliance on mechanized equipment to prep roads and build containment lines; Requires specialized equip (feller/buncher); some limited need for hand crews to build fireline, but mostly needed to perform burn out and hold firelines with most significant hand crew engagement needed to perform mop-up and post-containment road safety mitigation (hazard trees); requires small but intensive air support primarily from rotor-wing (T2 & T1 Heli) for direct crew support during burn out and holding. Approximately 600 personnel & 5 Aircraft

Expected Duration/Size:

Approximately 14 days to complete fire line construction, burn out and holding actions with additional 7 days for mop-up/repair; another 7 days to monitoring of easterly spread may continue well into early October. Assuming control actions work and FSPro projections are accurate, there is a 40-59% chance that the final fire size could reach somewhere around 40,000 acres.

Alternative C: No Action

This Alternative is explored for the sake of discussion to gain an understanding of why any action at all is required. This alternative is not necessarily viable but it is worth exploring in order to clearly understand why we might endeavor to engage this fire at all.

Expected Peak Resource Commitment:

Minimal – some remote monitoring, public information and law enforcement but no direct firefighter activity except to respond to life/structure threat.

Expected Duration/Size:

25 - 35 days – Approximately September 24 to hit 50% chance of a season ending event, October 5 to hit 75% chance; the median fire size according to FSPro projections is 65,000 acres.

Fire: Terwilliger	Area: Willamette NF	Date: 9/2/2018

Strategic Alternatives

	Strategy A: Tight Direct/Indirect	Strategy B: Extended Indirect/Direct	Strategy C: No Action
Description:	Keep the fire as small as practical using direct attack when feasible recognizing that effective firefighting and safety concerns often require indirect attack using closest available roads/ridges. Harvey Cr/Starr Cr on the SE; FSR 1993 on NE; no action to the east	Indirect control emphasizing use of existing roadways and natural fuel transitions to facilitate effective/efficient control and mitigate firefighter risk. FSR 1980 & 2618 on SE; Constructed fireline from Cougar Dam up to Avenue fire scar on NE; no action to the east	This Alternative is explored for the sake of discussion to gain an understanding of why any action at all is required. This alternative is not necessarily viable but worth exploration in order to clearly understand why we might endeavor to engage this fire at all.
Resource Commitment:	~ 600 personnel & 5 aircraft; Similar to current organization	~ 600 personnel & 5 aircraft; Similar to current organization	<50 personnel
Duration:	14 days to complete SW; 21+ days to complete NE; 30+ days of monitoring eastern spread	14 days to complete SW; 21+ days to complete NE; 30+ days of monitoring eastern spread	30+ days
Approximate Size:	27,000 acres	40,000 acres	65,000 acres

Risk to Values

Prioritized Values	Risk	Comments	Risk	Comments	Risk	Comments
Private Commercial Timber	Moderate		High		High	
Private Timberlands to West/North						
Private Property	High		High		Very High	
Communities & Property to the North						
Federal Commercial Timber	High		High		Very High	
Current "sold" timber sales						
Future timber sales						
Other Natural Resource Values	Moderate		High		Very High	
Threatened & Endangered Species						
Recreation Opportunities						
Water Quality						
Public Health & Safety	High		High		Very High	
Threats to members of the public						
Smoke/Air Quality						
Maintaining Dam Operations						

Firefighter Risk

Probability of Success

	Strategy A	Strategy B	Strategy C
Rating:	North / South = Mod	North / South = High	
Comments:			

Consequences of Failure

	Strategy A	Strategy B	Strategy C
Rating:	North / South = use Strat B as backup	North = have no backup / South = no backup, more damage	
Comments:			

The RMAT team facilitated the TOA with participation from Army Corps of Engineers, local fire district, ODF, Douglas Forest Protection Unit, local Sheriff, IMT members (IC, Deputy IC,

Ops, and Safety), Forest Supervisor, Deputy Forest Supervisor, Forest Fire Staff, District Ranger and District FMO.

After completing the TOA exercise, the general consensus among the participants was that Strategy A tended to best protect the values at risk, but it also exposed firefighters to more risk than Strategy B. Participants generally agreed that Strategy B was more likely to succeed than Strategy A, however the consequence of failure should Strategy B not succeed was much greater than that for Strategy A because it left little room to recover before encountering not only private timber lands, but also communities. In all instances however, there was general agreement that there were diminishing returns and increasing risk to firefighters associated with any attempt to try and confine fire spread to the east within the Wilderness and in proximity to recent fire footprints.

Participants for the TOA exercise provided feedback for the products and processes used during the RMAT assignment. One item of note was that the TOA process could benefit from more guidance on characterization of Consequence and/or Probability when using the Risk to Values Matrix which could speed up the process by making it more understandable.

Appendix A: Fire Behavior & Weather Outlook for the Terwilliger Fire

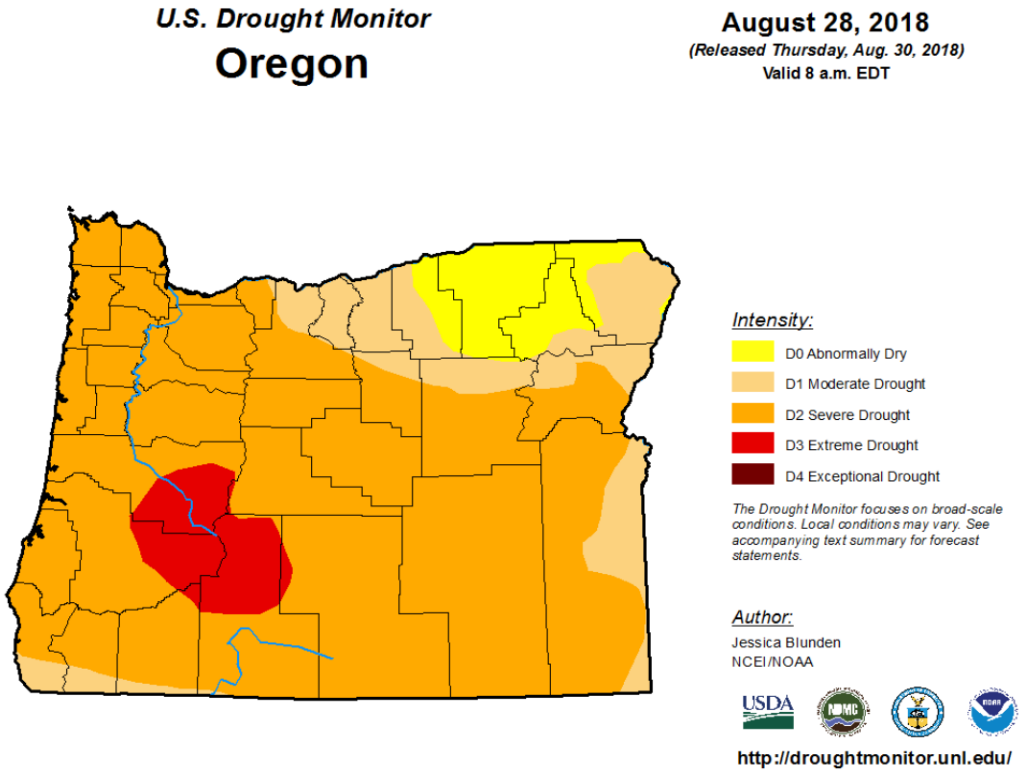
Date: Sept. 2, 2018
Analysts: Rick Stratton (LTAN)

Background & Purpose

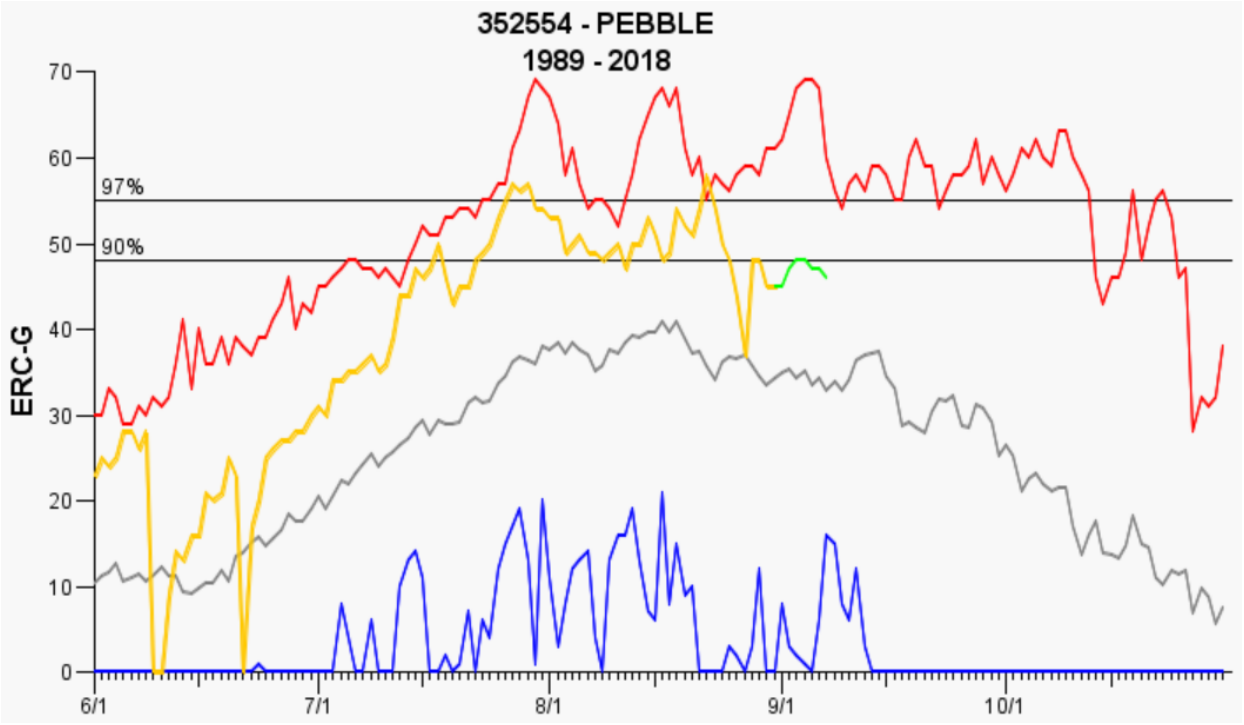
The Terwilliger Fire was reported on Aug. 19, and is currently burning on the east and west side of Cougar Reservoir, including the Three Sisters Wilderness. Terwilliger Hot Springs, a favorite recreational site on the WIF, is located on the west side of the Reservoir and near the start. The fire is about 8,000 acres, burning in tall timber, with a brush and moderate dead and down understory. Terrain is very steep, ranging in elevation from 1,700 to 5,000 ft. The purpose of this outlook is to provide line officers and fire manager's information on climatology and a short, near, and long-term assessment.

Climatology

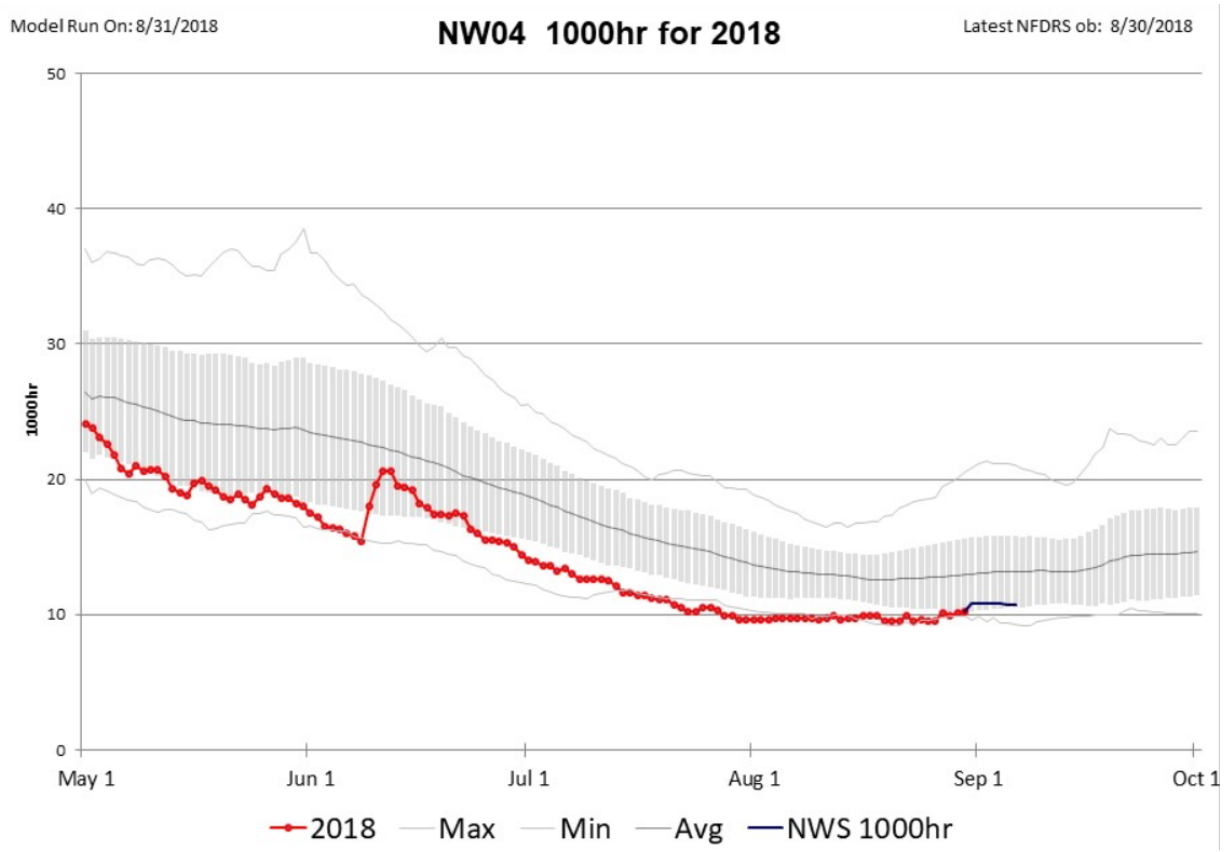
The U.S. Drought Monitor currently identifies the Terwilliger Fire area in **severe to extreme drought**.



Looking at Energy Release Component on the WIF (Pebble RAWS), ERCs are just below the **90th percentile**, with the short-term forecast flat (shown in green).

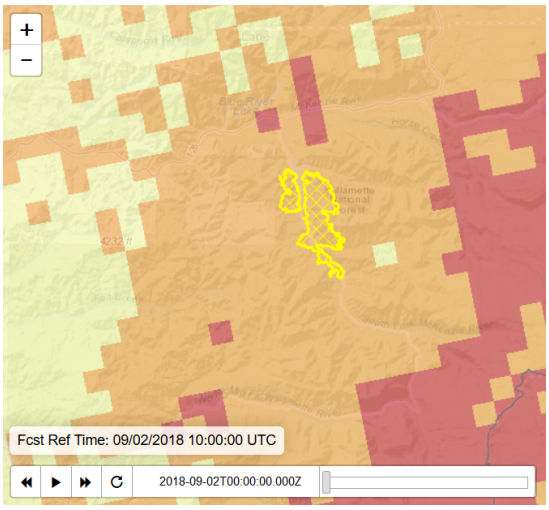


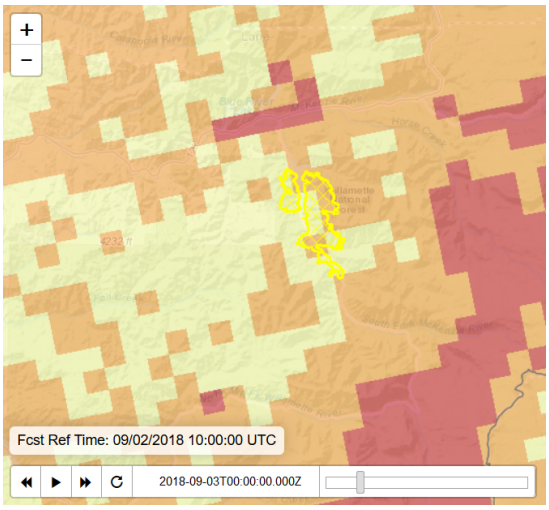
Dead fuel moistures were setting record lows for a month, but with recent moisture, the index is now just above the historical minimum (based on 9 key RAWS in NW04 from 1990 to 2017).



Short-term Outlook (next 2 days)

The WFAS severe fire weather potential mapping system provides users with a tool to spatially assess conditions for the current day and tomorrow. Sept. 2 (left) and 3 (right) are provided below, showing **high to very high potential**. For more information about this product visit **https://m.wfas.net/,** and click on the layer icon in the upper right.

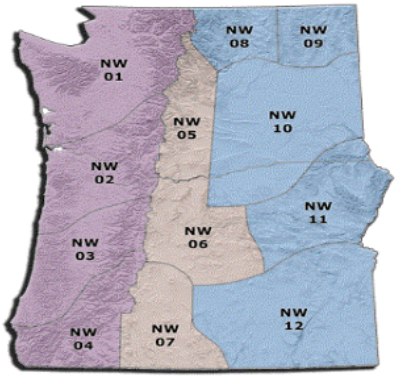




Mid-term Outlook (3 to 14 days)

Pacific Northwest 7-day significant fire potential outlook is provided below (**normal to elevated risk** [NW04])

(https://gacc.nifc.gov/nwcc/content/products/fwx/guidance/DL.pdf).



Legend

Fire Environment (FEN) 4 levels	
Minimal	- The Overall Fire Environment suggests a very low risk for Large fires (**less than 1% chance**)
Normal	- The Overall Fire Environment suggests a normal risk for large fires (**1 - 4% chance**)
Elevated	- The Overall Fire Environment suggests a moderately high risk for large fires (**5 - 19% chance**)
High Risk	**The risk for large fire(s) is very high (≥ 20%)** **Triggers: 1. ↯ (Significant Lightning)** **2. BEN (Critical Burn Environment)**

The assessment of the overall fire environment considers multiple factors including weather, lightning amount and fuel dryness. Large Fire probabilities are derived objectively via statistical methods. High Risk levels (≥ 20% probability of a large fire) are almost always due to significant lightning as burning conditions alone rarely result in a large fire probability much above about 10%.

Pacific Northwest
7 Day Significant Fire Potential

PREDICTIVE SERVICES

Saturday, September 1, 2018

Predictive Service Areas	ytd	tdy	Sun	Mon	Tue	Wed	Thu	Fri
NW01								
NW02								
NW03								
NW04								
NW05								
NW06								
NW07								
NW08								
NW09								
NW10								
NW11								
NW12								

Fire Potential: Moderated potential for new large fires is expected through the Labor Day weekend. General winds are decreasing for most of the geographic area except sections of southwest Oregon where warm, dry and breezy conditions continue. Fire Danger indices remain at average or above average for most PSAs except NW01 and NW02.

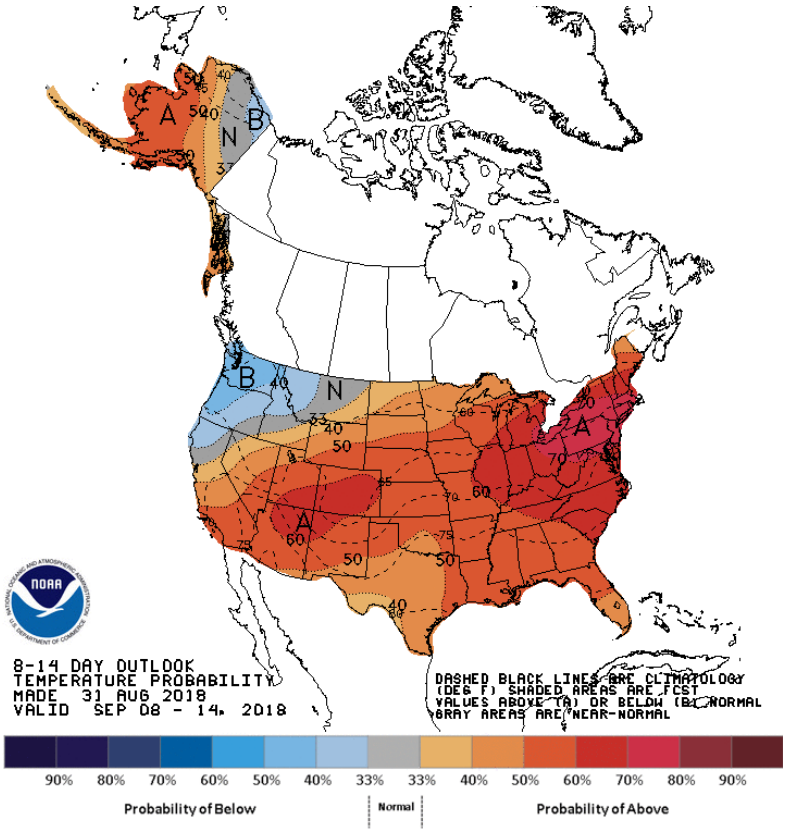
Check your NWS forecasts and advisories for the latest details for your area.

Preparedness Level:

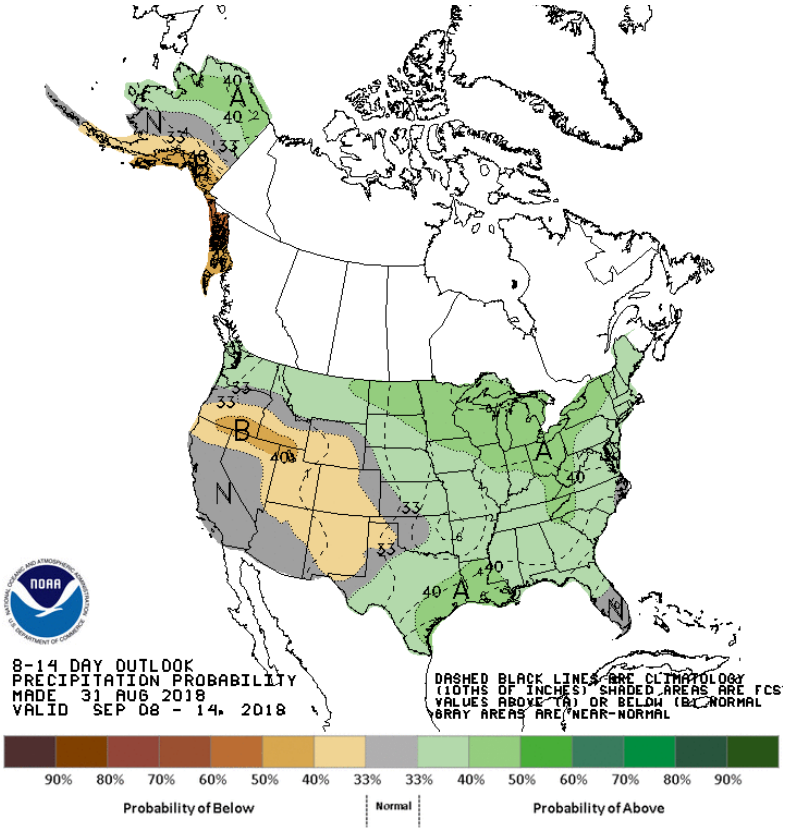
Northwest: 4
National: 4

- John Saltenberger

8 to 14 day outlook from the NWS is a 40 to 50% chance for **below normal temperatures**.



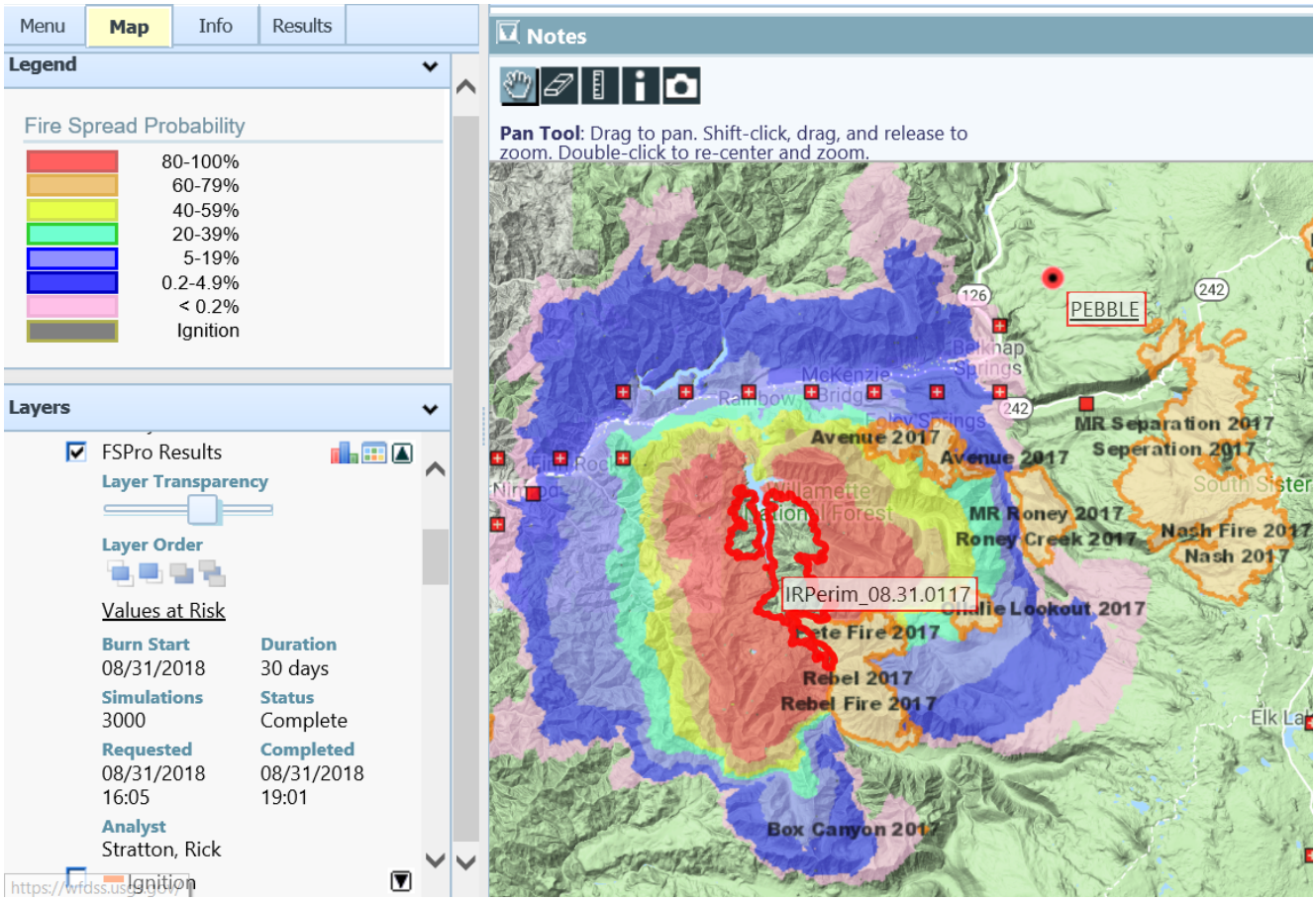
8 to 14 day outlook from the NWS is for **normal to below-normal** precipitation.



Long-term Outlook (1 to 2 months)

Fire Spread Probability

FSPro is a two-dimensional, ensemble simulation system that creates a probability surface from thousands of different fire "footprints" on the landscape for a given time period. The model incorporates terrain, fuels, fuel moisture, and forecasted and historical weather and winds. A **30-day run** was developed using 3,000 fire simulations.



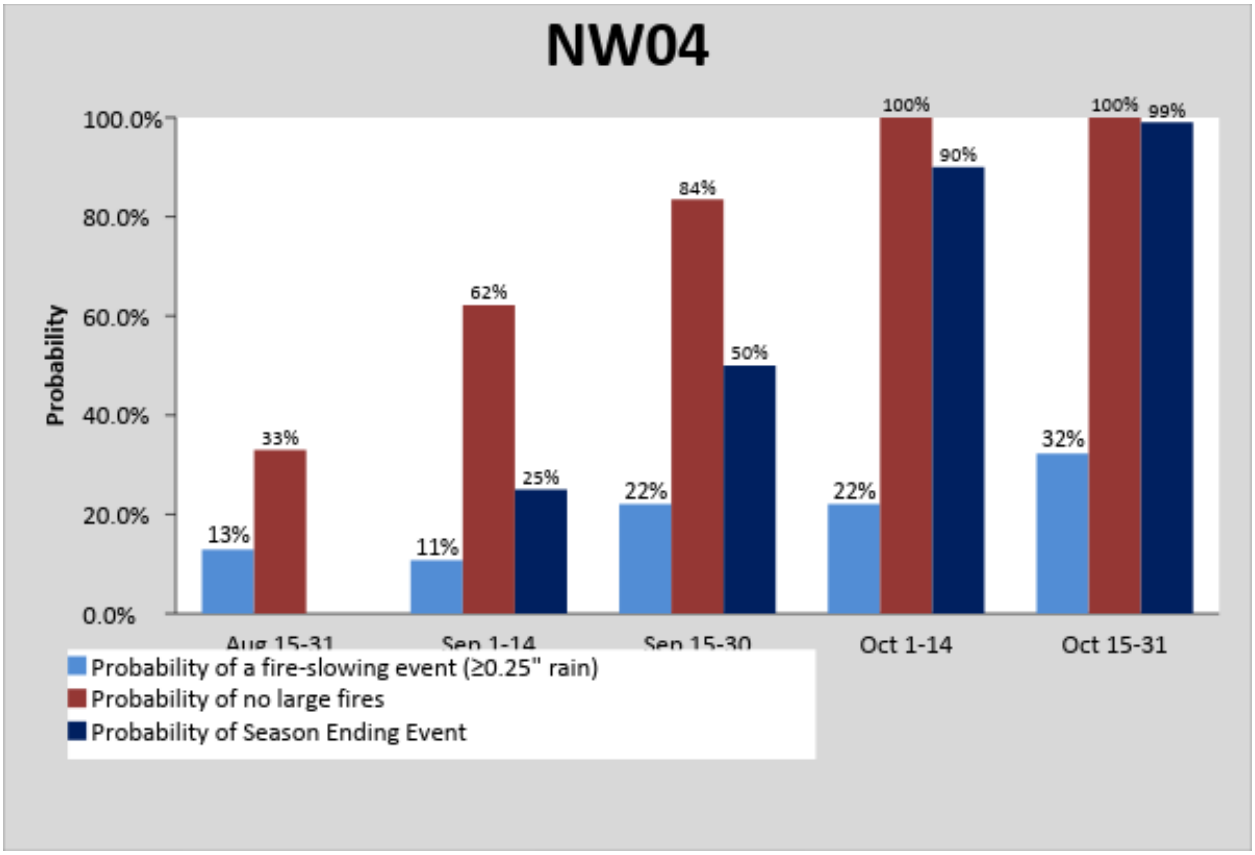
Probability of Large Fires, Fire-slowing, and Season-ending Events

Below are column charts for PSA NW04 based on the probability of experiencing another large fire, a fire-slowing event, and a season-ending event. The large fire occurrence data was obtained from NWCC (T. Marsha) for an 8-year period. A large fire differs in size based on the PSA, so think of this as the probability of a fire requiring a type 1 or 2 team.

Season-slowing information was obtained through a query of the PSA Special Interest Groups (SIGs)—a group of RAWS. A ¼" of rain was selected as a fire-slowing event, as several forecast areas use this criterion as a "wetting rain." Fires that receive approximately a ¼" of precipitation are likely to see fire movement pause for a few days.

A season-ending event consists of a fire-slowing event followed by a persistent combination of environmental factors that end the fire season. NWCC develops waiting-time distribution functions—or TERM events—for each PSA by using a SIG. Season-ending estimates were constructed from the Predictive Services 7-day significant fire potential product from 1994

to 2012. The product determines the probability of a significant fire occurring based on historical dryness and fire occurrence. The analysis results assume the end of the season when three or more consecutive “green” days occur (1% probability of a significant fire event). All PSA TERM files are at the bottom of the “Fire Analysis” page of the NWCC website (http://gacc.nifc.gov/nwcc/predict/fban-ltan.aspx). **Sept. 24 there is a 50% probability for a season-ending event; this increases to 75% on Oct. 5**.



Large Fire Growth Triggers

Typically large fires on the western slopes of the Cascade Mountains grow in size on relatively few days during the lifespan of the fire. These growth days are often associated with wind events, warm and dry air masses, and atmospheric instability. These factors are common with thermal troughs (a heat low). Thunderstorms can also contribute to large fire movement, but at this time of the year, they are generally wet.

Thermal troughs are a critical fire weather pattern in the Pacific Northwest. This elongated area of low atmospheric pressure tends to boost temperatures, drop humidity, and increase instability. They usually have a high forecast accuracy and often develop near the Pacific coastline of Washington and Oregon, then progress gradually inland and eastward over the following days. They are commonly associated with Haines 5 and 6 days. The presence of thermal troughs has been associated with rapid rates of spread, extreme fire behavior, and plume-dominated fires. The RSF, UPF, and WIF have a rich history of such events, including Rattle 2008, Tumblebug, Boze, and Rainbow 2009, Lonesome and Garwood 2011, and more recently Deception Creek 2014 and Chetco Bar 2017.

Strong, easterly winds can blow across the western slopes of the Cascade Mountains when a thermal trough moves to the Oregon coastline and high pressure increases east of the Cascades. This strong downslope wind usually brings low relative humidity and poor

humidity recovery at night. This Foehn wind can occur any time of the year but are most problematic during late August, September, and October. East wind events can persist for 24 to 48 hours or longer with surface winds commonly 30 to 50 mph. Generally, wind velocities reach maximum strength during the night and early morning hours. Per a discussion with John Saltenberger, meteorologist at Predictive Services, the frequency of thermal troughs and associated east winds in September range from 1 to 6 occurrences, with **3 being most likely in 2018**.

Conclusion

The Terwilliger fire is located in an "ok" location—recent big fires to the east; away from a major travel corridor or concentration of homes; an abundant water source close by; wilderness and agency lands, particularly to the east, south, and SE. The tricky part is we still have a month+ of fire season with the threat of thermal troughs, instability, and east winds. This waiting game can be likened to a three horse race. One horse is the chance for a fire-slowing event moderating conditions—like the modest respite we received last week. The pro with this horse winning is it stalls fire growth for a few days, BUT the horses again go to the starting gate. The 2nd horse is a season-ending event—successive season-slowing events culminating in the termination of the fire season. Lastly, is the dreaded horse—the large fire trigger. The *sequence* of this race or races will define the final lap of the 2018 fire season.

Appendix B: Observed Best Management Practices (Forest and IMTs)

- Forest was exceedingly welcoming and engaging
- READ organization and program highly functioning and effective
- Clear AA/AAR roles and responsibilities
- Alignment between the WFDSS and IAP was excellent. Leader's intent specific to this fire.
- Apparent good relationships with partners and cooperators.

Appendix C: RMAT Lessons Learned & Best Management Practices

TOA Meeting AAR

- Providing the framework of the Probability of Success/Consequences of Failure to VARs provided by Tim Sexton was well received and being able to adapt to the dialogue for end result.
- FF Risk Assessment was explained very well by Tim Sampson. Soliciting local expertise and IMT Safety knowledge was crucial to bringing them into the building of the data that was presented.
- VAR part went well, maybe cut it too short? Try to keep number of values identified to a minimum, five to six seems good.
- Suggestion for paring down the risk matrix table.
- Removed the Social/Political, Partner/Cooperator, Other factors of showing separately and intended to cover those aspects during the VAR discussion but that didn't happen.
- Participants showed interest in the products - how they are made and how we use them. So the overview of what the team had available was a good stroke.
- At the end, review the results, either go over the template again or have it automatically create a summary of the data that can be displayed after the exercise is completed.

- Wrap up the exercise with what the participants are leaning towards for their strategic choices - did it change? And then go into the AAR on the process itself.
- Good referencing back to the SDI and PCL throughout the exercise.
- Time management important and today was well managed.
- Feedback on the process back to the team members when Lead closes out with Region.
- Being flexible and adaptable in the presentation of material.
- TOA is getting closer and operating at the right level - getting to the right package so we have a good foundation to launch from.
- Need to have the entire list of all VAR captured and displayed, then use a scaled down version for the TOA from AA input of what affects their decision - make sure to identify that up front to the participants.

RMAT Members AAR

- What are our ripples? If we hadn't come to this assignment what would they have done differently or not especially from the AA perspective.
- Important to continue to do the standup/check-in's with team members and sharing of logistical information.
- Inbriefings have become more structured. In order to be transparent would mean to not limit who attends the inbrief.
- Equipment kits should have been available way earlier in the summer - allows for a professional presentation and not having to rely on team members to provide specialty items the units may not have.
- Timing the RMAT arrival on or around an IMT transition seemed to be a good time to help the AA as they work on the DoA for the incoming team.
- AAs very welcoming and willing to provide any help that the team needed.
- Having the SDI and PCL's available when the team shows up is very helpful.